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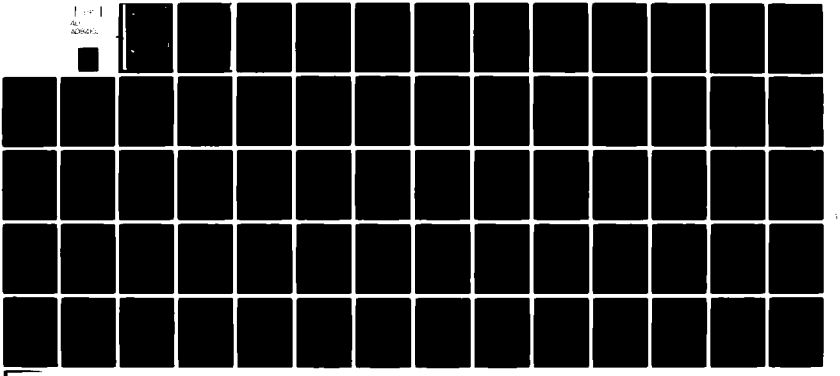

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UNRECORDED WIDEBAND [illegible]
REFERENCE TAPE FEASIBILITY STUDY

Frequency Response Results

(AIRTASK A6306302-954D-8W06040000, Work Unit [illegible])

By

D. R. HUST
Weapons Instrumentation Division

26 March 1980

PACIFIC MISSILE TEST CENTER
Point Mugu, California 93042

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An investigation was conducted to determine signal response variations when a variety of wideband instrumentation magnetic tapes is used on a cross section of recorder/reproducer systems. Data for the investigation were collected by transmitting a set of eight sample test tapes to participating data recording/reproducing facilities for the purpose of making data measurements. Data collected represent measurements made with 16 different recorder/reproducer systems at 11 different testing facilities located throughout the United States. The data-collection process involved approximately 2 years of testing. The originating/coordinating facility was the Pacific Missile Test Center, Point Mugu, California.

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20. ABSTRACT *(Concluded)*

The test results indicated the following: All of the sample test tapes exhibited bidirectional performance within the limits of measurement repeatability; overall system stability was better in the low-band regions than in the upper-band regions; and the overall relative frequency response of the sample test tapes did not change appreciably during the 2-year investigative period. The most significant result of the test measurements is that at least 90% of the frequency response values were within ±2.0 dB at all frequencies. Machine stability factors such as azimuth, equalizer, and gain changes had more effect on data variability than did magnetic tape or tape speed.

The use of a reference tape system is recommended as a method to assure that relative frequency response variations will be less than or equal to ±2.0 dB.

ACKNOWLEDGMENT

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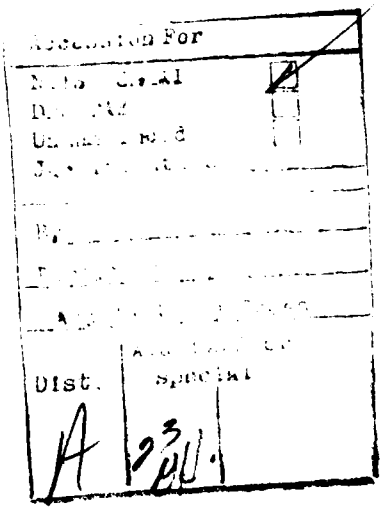

CONTENTS

CONTENTS (Concluded)

NOMENCLATURE

dB	Decibel
Hz	Hertz
in/s	Inches per second
kHz	Kilohertz
MHz	Megahertz
R1	Run one of reference tape
R2	Run two of reference tape
S1 - S7	Sample tape 1 through sample tape 7
UBE	Upper band edge
%	Percent, percentage
10% UBE	*10 percent of upper band edge*

TP-80-05
26 March 1980

PACIFIC MISSILE TEST CENTER
Point Mugu, California 93042

UNRECORDED WIDEBAND INSTRUMENTATION REFERENCE TAPE FEASIBILITY STUDY

Frequency Response Results

(AIRTASK A6306302-054D-8W06040000, Work Unit A6302D-02)

By
D. R. HUST

SUMMARY

An investigation was conducted to determine signal response variations when a variety of wideband instrumentation magnetic tapes is used on a cross section of recorder/reproducer systems. Data for the investigation were collected by transmitting a set of eight sample test tapes to participating data recording/reproducing facilities for the purpose of making data measurements. Data collected represent measurements made with 16 different recorder/reproducer systems at 11 different testing facilities located throughout the United States. The data-collection process involved approximately 2 years of testing. The originating/coordinating facility was the Pacific Missile Test Center, Point Mugu, California.

One of the eight sample test tapes was selected and designated as the "Unrecorded Reference" tape. The reference tape was used during recorder/reproducer system adjustments and to make a set of reference measurements; the remaining sample tapes were marked as sample tapes 1 through 7 and were used to make performance measurements only. Frequency response measurements were made to determine tape bidirectional performance, system stability at each test facility, sample test tape stability during the entire investigation, and the variations in frequency response over the cross section of recorder/reproducer systems used to conduct test measurements. Performance measurements were made at tape speeds of 30 and 120 in/s.

The test results indicated the following: All of the sample test tapes exhibited bidirectional performance within the limits of measurement repeatability; overall system stability was better in the low-band regions than in the upper-band regions; and the overall relative frequency response of the sample test tapes did not change appreciably during the 2-year investigative period. The most significant result of the test measurements is that at least

90% of the frequency response values were within ±2.0 decibels (dB) at all frequencies. Machine stability factors such as azimuth, equalizer, and gain changes had more effect on data variability than did magnetic tape or tape speed.

The use of a reference tape system is recommended as a method to assure that relative frequency response variations will be less than or equal to ±2.0 dB.

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INTRODUCTION

An investigation to determine the variations in signal response of different wideband instrumentation magnetic tapes when a cross section of recorder/reproducer systems is used was conducted under AIRTASK A6306302-054D-8W06040000, Work Unit A6302D-02, to provide technical support to the Telemetry Group of the Range Commanders Council.

Missile test ranges and other facilities involved in data handling rely on the characteristics of magnetic tapes and recorder/reproducer systems to provide uniform performance and compatibility in interchange or cross-play operations. Prior to this investigation, studies had been conducted to determine the effects of variations in record bias level, record signal level, harmonic distortion content, and record-head gap length. However, the need for additional information to maintain close control of performance characteristics provided the impetus for this investigation. A primary purpose of the study and experimentation was to collect information that may be used by the Telemetry Group to determine the desirability of establishing a standard unrecorded reference tape system. Technical support during the investigation was provided by the Recorder/Reproducer Committee of the Telemetry Group and the X3B6 Committee of the American National Standards Institute (ANSI).

Careful consideration was given to the type of tests conducted and to the method of data collection. A comprehensive set of test procedures was generated, and initial tests were conducted at the Pacific Missile Test Center, the coordinating facility, using eight commercially available state-of-the-art one-half-inch wide sample test tapes (for use on seven track systems). Since the objective of the task required data from a cross section of recorder/reproducer systems, it was determined that a round robin approach of transmitting the sample tapes from facility to facility throughout the United States would provide the best method of data collection. The test procedures accompanying the test tapes required that tests be conducted to measure frequency response, harmonic distortion content, and signal-to-noise ratio. However, to expedite release of the test results, only the results of the frequency response measurements are included in this publication. The results of the remaining tests and measurements will be made available through a future publication.

TEST METHODS

The objective of the investigation was to conduct a program of testing to determine the variations in signal response when a mixed group of sample test tapes is used on a cross section of recorder/reproducer systems. Therefore it was necessary to assure that other characteristics of the magnetic tapes, recorder/reproducer systems, or the system test setup did not influence the test results. In addition, test controls were included in the design of the test procedures to provide as much assurance as possible that the test procedures would provide repeatable results. A laboratory recorder/reproducer system with new heads was dedicated to this study.

Eight sample tapes were obtained for the investigation. Each was rewound onto precision glass reels, run-in a minimum of five complete passes, and then performance-tested on a controlled laboratory recorder/reproducer system. Preliminary measurements were made to identify the performance characteristics of each sample test tape and to obtain relative performance comparisons between tapes. The tapes were then relabeled to assure anonymity of tape type and manufacturer. The sample test tape exhibiting performance characteristics approximately midway

among those of the eight tape samples was designated the "Unrecorded Reference" tape sample; the remainder were designated sample tapes 1 through 7 (S1 through S7). The measurements made with the Unrecorded Reference tape were then used as the reference values for each test site when the data analysis was performed.

Tests were conducted at tape speeds of 30 and 120 in/s, with the tape run in both directions (bidirectionality), and at test frequencies from lower band edge through upper band edge. System adjustments were made only while the Unrecorded Reference sample test tape was used. Test measurements were then made with each sample tape without making further adjustment other than the reproduce-head azimuth adjustment, which was optimized with each sample tape before data measurements were taken. System stability and data repeatability were monitored by using the Unrecorded Reference tape to make initial and final test measurements. Performance measurements were made on track number 4, a requirement necessary to determine the bidirectional performance characteristics of the test tapes. To determine whether the performance of the sample test tapes had remained constant over the duration of field testing, the first and last set of data measurements were made at the coordinating facility (the Pacific Missile Test Center).

The test procedures included system setup procedures based on the IRIG Standards specific procedures to be followed in making performance measurements, and data sheets for recording the measured values (see appendix A).

Specifically, the procedures required that the recorder/reproducer system be set up using only the sample tape designated Unrecorded Reference and that all subsequent measurements be made with the degaussed sample tapes without further system adjustments except for reproduce-head azimuth, which was adjusted with each sample tape. Data measurements were made at tape speeds of 30 and 120 in/s. Frequency response measurements were made for nine different frequencies within the recorder/reproducer system bandwidth. Additional measurements included harmonic distortion content and signal-to-noise ratio measurements; however, the results of these measurements are not included in this report. They will be provided in a future report.

Participants for the study included government and industry facilities which were located throughout the United States. Data were collected from the participating facilities by transmitting the package of sample tapes and test procedures in round robin fashion until all the designated facilities had completed the required tests. Initial and final tests were conducted at the Pacific Missile Test Center, Point Mugu, California, the coordinating facility for the study.

FREQUENCY RESPONSE TESTS

As stated previously, the recorder/reproducer system used to make performance measurements was adjusted with the sample tape designated as the Unrecorded Reference tape. Frequency response measurements were then made with the use of this tape. Sample tapes 1 through 7 were used for subsequent measurements without making further adjustments other than the reproduce-head azimuth, which was adjusted with each sample tape before the data measurements were taken. Upon completion of these tests, a second set of measurements--to provide information on system stability and data repeatability--was made using only the Unrecorded Reference tape. Data reduction between the first and second run of the Unrecorded Reference tape was done to reveal the spread in data when the same tape on the test system was used at the beginning and end of the test sequence. The data taken with sample tapes 1 through 7 were normalized to the data taken with the Unrecorded Reference tape for each recorder/reproducer system. Since the objective of the study was to determine the variations in response when the sample tapes were used on a variety of systems, the analysis routine attempted to determine the usefulness of an Unrecorded Reference tape system to tape interchange operations.

Frequency response measurements were made at tape speeds of 30 and 120 in/s for nine different frequencies within the recorder/reproducer bandwidth. Frequencies used were as follows:

Tape Speed of 120 In/s (kHz)	Tape Speed of 30 In/s (kHz)
10% UBE*	10% UBE*
0.8	0.8
12.0	3.0
120.0	30.0
480.0	120.0
960.0	240.0
1200.0	300.0
1500.0	375.0
2000.0	500.0

*UBE = Upper band edge.

In an effort to determine the bidirectional characteristics of the tapes, tests were conducted with each sample tape running in both directions. The recorder/reproducer system was always set to run in the forward mode of operation. At completion of field data collection, the tape samples were returned to the coordinating facility, the Pacific Missile Test Center, where final tests were conducted. These test results were used to make comparisons with the data taken at the beginning of the study.

RESULTS

Bidirectional Tape Performance

To measure bidirectional performance, data were collected with each sample tape. The recorder/reproducer systems used to conduct tests were operated in the forward mode of operation; bidirectional measurements were made by interchanging the supply and take-up reels (tapes were run in both directions). The data analysis routine determined the differences, in decibels, between the forward and reverse measurements and then grouped the differences to form cumulative distributions across test sites. Figures 1 and 2 show the cumulative distributions in ±0.5-dB intervals at tape speeds of 30 and 120 in/s. The distributions are shown for the measurements made at frequencies corresponding to 10% of the UBE and at the UBE. Because of the time required to run these tests, some test sites did not provide data for bidirectional performance. However, the data shown for a tape speed of 120 in/s are comprised of 104 measurements; at 30 in/s, 80 measurements. These are the total number of data measurements made at each frequency. The combined results from all test sites, both tape speeds, and at 10% UBE and at the UBE show that 88.4% to 94.7% of the difference values were within ±0.5 dB and that 96.8% to 98.9% were within ±1.0 dB. The lower values are the result of measurements made in the UBE regions, where azimuth misalignments and differences in system performance are most likely to influence variations in data measurements.

Comparison of Initial to Final Data

Initial tests before field testing and final tests at the completion of field testing were conducted at the Pacific Missile Test Center on a recorder/reproducer system that had been dedicated to the study. Comparisons were made to determine whether the relative performance characteristics of the sample tapes had changed during the data collection process, which took approximately 2 years to complete. The sample tapes were run a large number of times and subjected to many environmental conditions during these 2 years. The Unrecorded Reference tape was run a minimum of 150 times, and each sample tape was run a minimum of 60 times. The results of the normalized data comparisons are given as cumulative distributions over all test frequencies and all sample tapes at tape speeds of 30 and 120 in/s.

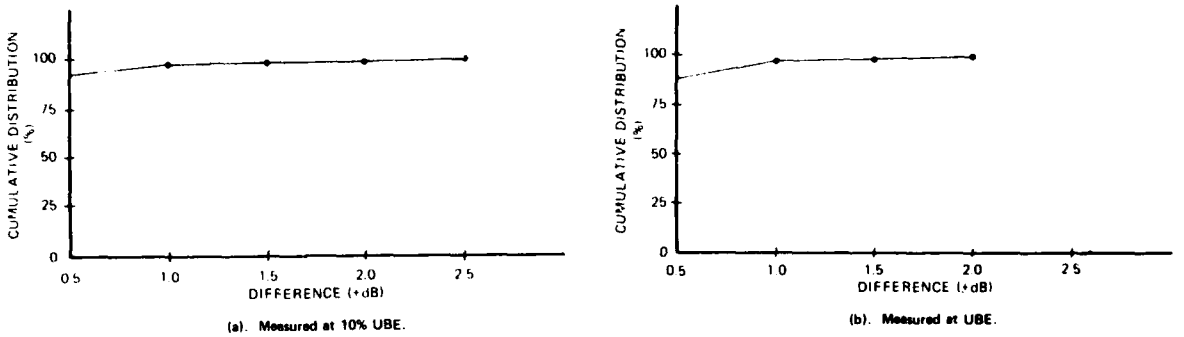


Figure 1. Difference Between Forward and Reverse Tape Data for All Sites and Sample Tapes at 10% of and at UBE (Tape Speed 30 In/s).

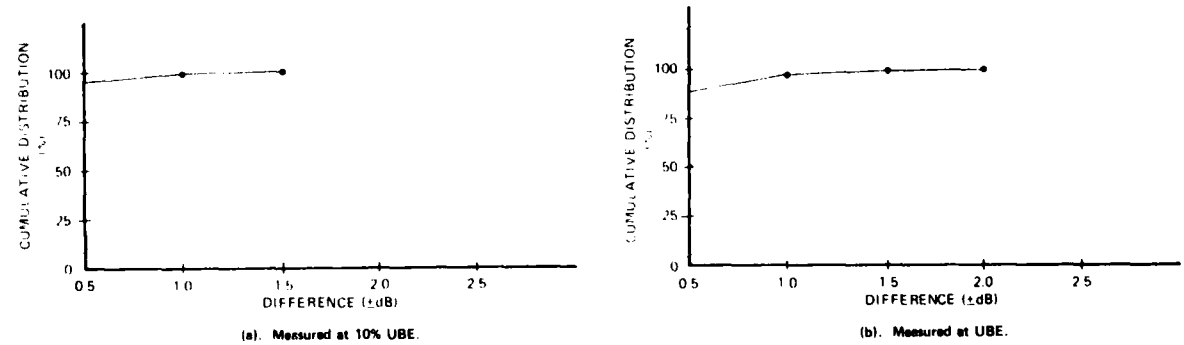


Figure 2. Difference Between Forward and Reverse Tape Data for All Sites and Sample Tapes at 10% of and at UBE (Tape Speed 120 In/s).

The cumulative distributions at a tape speed of 30 in/s, figure 3, show that 94.6% of the differences were in a range of ±1.0 dB and 100% were within ±1.5 dB. The results of the data comparisons between initial and final tests at a tape speed of 120 in/s (figure 3) show that 92.9% were within ±1.0 dB, 98.2% were within ±1.5 dB, and 100% were within ±2.0 dB.

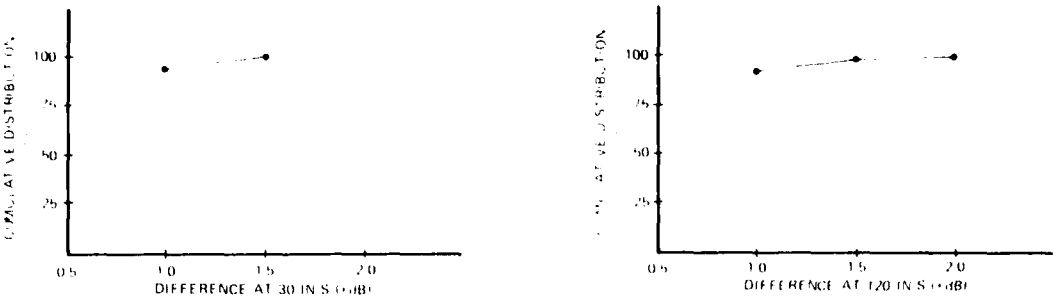


Figure 3. Difference Between Initial and Final Test Data, All Test Frequencies and All Sample Tapes (30 and 120 In/s).

Comparison of First and Second Run of the Reference Tape

The results of the frequency response tests are presented as cumulative distributions (in percentages) for each frequency at which the amplitude was measured. The reference values for making comparisons are the amplitude values measured with the Unrecorded Reference tape sample; refer to appendix B for details of the data processing employed. As explained previously, the reference tape was used to make measurements at the beginning of each set of site measurements and then again at the end of testing. The first and last set of data measurements using the reference tape sample are designated as R1 and R2; these data are used to determine system stability and data repeatability. The differences in decibels between the R1 and R2 values were calculated, and the cumulative distributions (in percentages) are shown in table 1 and figures 4 and 5 for each measurement frequency. The data are presented for intervals of ±1.0, ±2.0, and ±3.0 dB only. Tables containing the cumulative distributions for +0.5-dB intervals are given in appendix C.

Table 1. Comparison of R1 and R2 Data. (See figures 4 and 5.)

No. of Measurements	Megahertz Class	Tape Speed (In/s)	Cumulative Distribution (%) Within		
			±1.0 dB	±2.0 dB	±3.0 dB
10	2.0	30	70 to 90	90 to 100	100
11	2.0	120	63.6 to 100	90.9 to 100	100
14	1.5 and 2.0 combined	30	64.3 to 92.9	90.9 to 100	100
16	1.5 and 2.0 combined	120	66.7 to 100	91.7 to 100	100

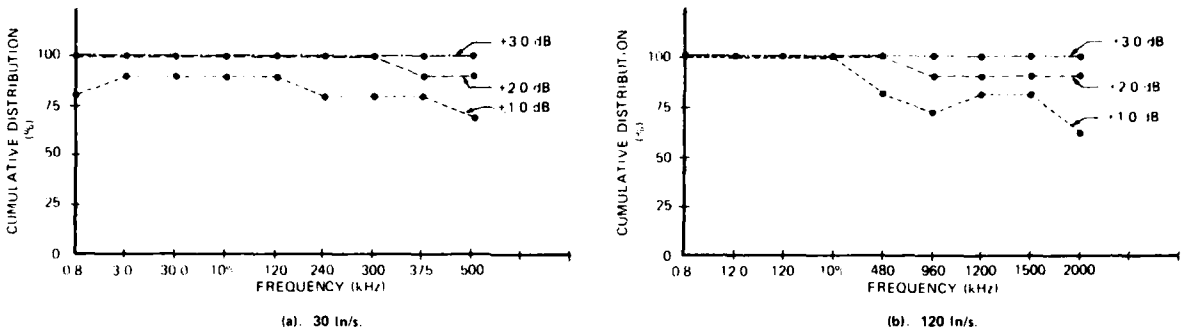


Figure 4. Difference Between R1 and R2, All Sites (30 and 120 In/s, 2.0-MHz Class Only).

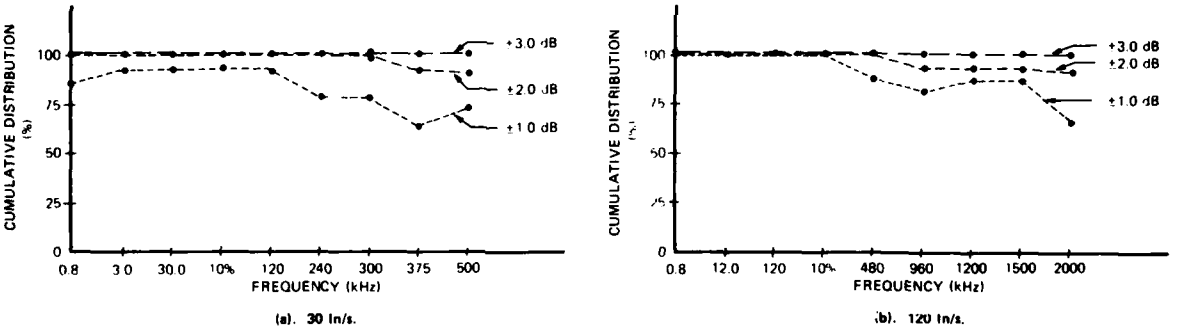


Figure 5. Difference Between R1 and R2, All Sites (30 and 120 In/s, 1.5- and 2.0-MHz Classes Combined).

Data measurements were made with the 1.5- and 2.0-MHz classes of recorder/reproducer systems; the results of data comparisons between R1 and R2 are given for the 2.0-MHz class alone and also with the two classes combined. Figure 4 shows the cumulative distributions for the 2.0-MHz class, and figure 5 for the 1.5- and 2.0-MHz classes combined.

Observations of the R1 to R2 data comparisons show that more than 90% of all the difference values in the figures are within ±2.0 dB at all frequencies. Further observations reveal that more than 90% of the difference values at a frequency of 10% UBE are within ±1.0 dB. The 10% UBE region of the system bandwidth is considerably more stable, since it is less affected by variations due to azimuth misalignments and tape or system performance.

Cumulative Distributions and Standard Deviations for Sample Test Tapes 1 Through 7

The cumulative distributions of the normalized data for all sample tapes and test sites combined are shown in table 2 and figures 6, 7, and 8. The data spreads represent the distribution of normalized values for each sample

Table 2. Cumulative Distribution Data From Sample Test Tapes 1 Through 7. (See figures 6, 7, and 8.)

No. of Measurements	Megahertz Class	Tape Speed (In/s)	Cumulative Distribution (%) Within	
			±1.0 dB	±2.0 dB
28	1.5	30	78.6 to 100	100
35	1.5	120	74.3 to 100	97.1 to 100
70	2.0	30	75.7 to 87.1	91.4 to 97.1
77	2.0	120	64.9 to 88.3	93.5 to 100
98	1.5 and 2.0 combined	30	70.1 to 91.8	87.0 to 98.0
112	1.5 and 2.0 combined	120	56.0 to 91.1	88.1 to 100

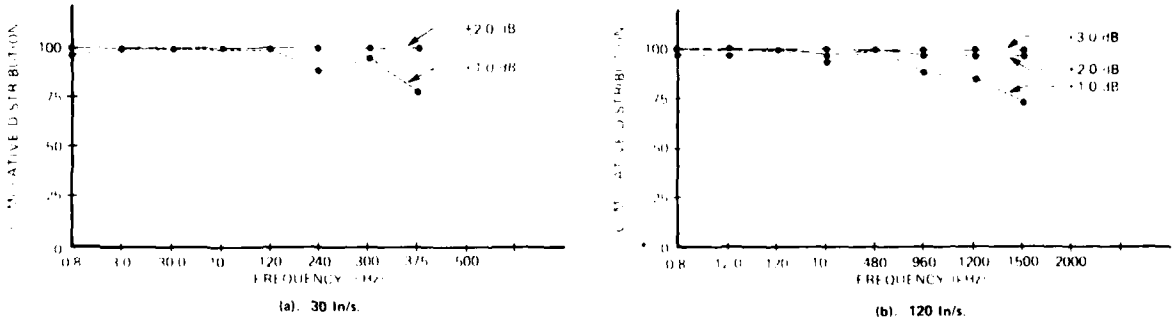


Figure 6. Cumulative Distribution, All Tapes and Sites Combined at 30 and 120 In/s (1.5-MHz Class Only).

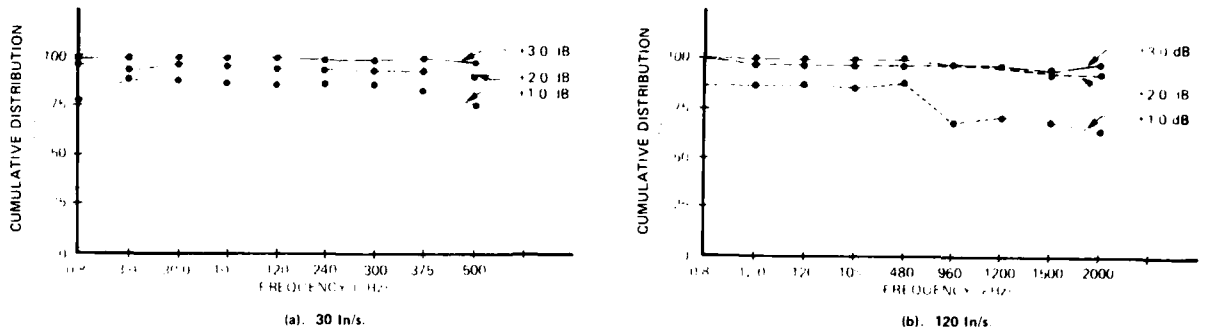


Figure 7. Cumulative Distribution, All Tapes and Sites Combined at 30 and 120 In/s (2.0-MHz Class Only).

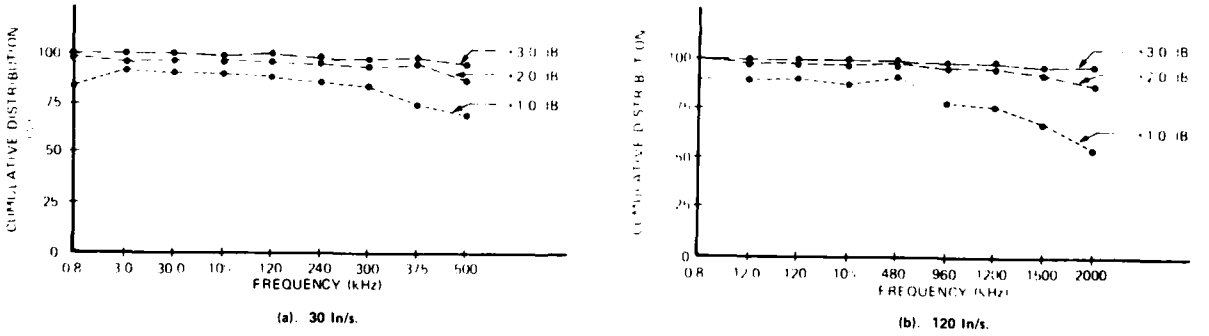


Figure 8. Cumulative Distribution, All Tapes and Sites Combined at 30 and 120 In/s (1.5- and 2.0-MHz Classes Combined).

tape about the average value for each sample tape at all test sites and are plotted for each measurement frequency. The cumulative distributions are shown for data spreads of ±1.0, ±2.0, and ±3.0 dB only; refer to appendix C for data at ±0.5-dB intervals. Since measurements were made using both the 1.5- and 2.0-MHz classes of systems, the data are presented to show the results for each class separately and then with both classes of data combined. It should be noted that the data set for the 1.5-MHz class is considerably smaller than for the 2.0-MHz class. The results show that at least 87.0% of the values are within ±2.0 dB for all groupings at all frequencies.

The standard deviations (σ), in decibels versus frequency, for the cases representing the sample tapes with the lowest and highest standard deviations, the R2 results, and the results from combining all sample tape and test site data (S1 through S7) are shown in figures 9 and 10. The data in the figures show the results at tape speeds of 30 and 120 in/s for the 2.0-MHz class alone and the 1.5- and 2.0-MHz classes combined. Observations of the data at 10% UBE and at the UBE for the 2.0-MHz class reveal a spread of 0.4 to 1.0 dB and 0.7 to 1.5 dB, respectively, at a tape speed of 30 in/s. At a tape speed of 120 in/s, the results show spreads of 0.3 to 0.9 dB and 0.7 to 1.6 dB at 10% UBE and at the UBE, respectively. When the data for the two classes (1.5 and 2.0 MHz) of systems are combined, the results reveal a spread in distribution of 0.4 to 1.0 dB at 10% UBE and of 0.7 to 1.6 dB at the UBE at a tape speed of 30 in/s. At a tape speed of 120 in/s, the results show a spread of 0.3 to 0.8 dB at 10% UBE and 0.9 to 1.9 dB at the UBE. The highest standard deviations are at the UBE frequencies.

The standard deviations for R2 and all sample tapes combined (S1 through S7) are shown in table 3 for the 2.0-MHz class of systems at both tape speeds, and at 10% UBE and at the UBE. When an "F"-test is performed on the equality of the variances of the four sets of the 10% UBE data, the result is that all data sets except R2 at 120 in/s appear to have the same variance, therefore, the same standard deviation. The four sets of data at the UBE also appear to have the same standard deviation, based on the F-test results. When the values at 10% UBE and at the UBE are compared, the result is that the standard deviation at 10% UBE cannot be assumed to be the

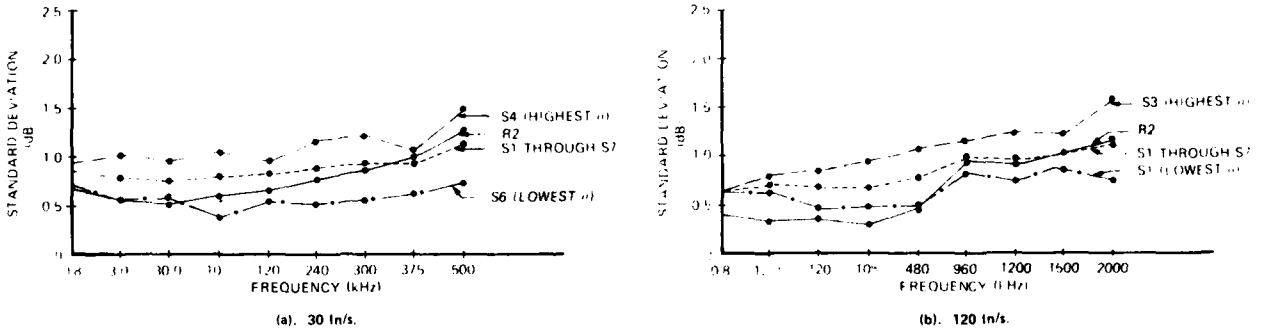


Figure 9. Standard Deviations for Amplitude Measurements Made at Specified Frequencies for Tape Speeds of 30 and 120 In/s (2.0-MHz Class Only).

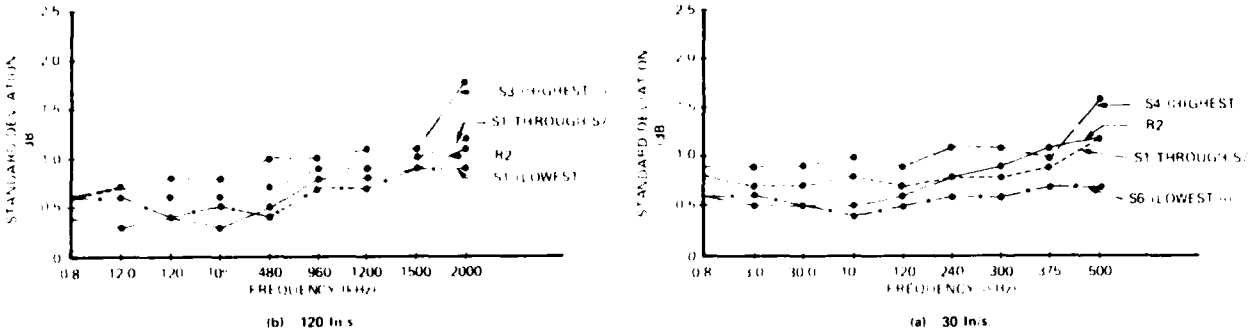


Figure 10. Distribution of Standard Deviations for Amplitude Measurements Made at Specified Frequencies for Tape Speeds of 30 and 120 In/s (1.5- and 2.0-MHz Classes Combined).

same as at the UBE. Therefore the data variability is approximately the same for R2 and the combined sample tapes at 10% UBE and 30 in/s. At the UBE, the data spread is approximately the same for R2 and the combined sample tapes at both tape speeds. The standard deviation for the combined sample tapes at 10% UBE is nearly the same at a tape speed of 120 in/s as at 30; however, these results are different than those for R2 at a tape speed of 120 in/s. The UBE standard deviations are larger than the standard deviations for 10% UBE.

The table also shows the interval within which 95% of the data are located for the combined sample tapes. Two times the standard deviation (2σ) falls within the same interval as the 95% value for all four sets of data shown.

Table 3. Standard Deviations (σ) and 95% Distribution Intervals for 10% UBE and UBE at Tape Speeds of 30 and 120 In/s (2-MHz Class Only).

Tape Speed/ Frequency	σ (dB)		2σ (dB)	95% Cumulative Distribution Interval (dB)
	R2	S1 Through S7	S1 Through S7	
30 In/s				
10% UBE	0.60	0.80	1.60	1.5 to 2.0
UBE	1.27	1.11	2.22	2.0 to 2.5
120 In/s				
10% UBE	0.29	0.68	1.36	1.0 to 1.5
UBE	1.14	1.11	2.22	2.0 to 2.5

R2 Second run of reference tape.
UBE Upper band edge.

CONCLUSIONS

Data repeatability, based on the method of round robin data collection and the absence of laboratory measurement controls, was expected to be no better than ±1.0 dB for the entire study. Therefore, since almost all the differences between forward and reverse data measurements are within ±1.0 dB it is concluded that all the sample test tapes provided bidirectional performance within the range of data repeatability.

The sample tapes were subjected to many environmental conditions during the 2-year course of data collection, and the tapes were run a large number of times to collect the data. During the data collection process, the Unrecorded Reference tape was run a minimum of 150 times, and each sample tape, a minimum of 60 times.

Comparison of the normalized data from the initial and final tests revealed that 94.6% of the differences were in a range of ±1.0 dB at a tape speed of 30 in/s and that 92.9% of the differences were in a range of ±1.0 dB at a tape speed of 120 in/s. Since nearly 95% of the differences are less than or equal to the ±1.0-dB value given to data repeatability for the study, it would appear that the overall relative frequency response performance of all the sample tapes did not change appreciably during the course of the study.

The difference values between the R1 and R2 measurements given in the frequency response results section represent the maximum and minimum excursions of the cumulative distributions for all frequency measurements. Observation of the individual cumulative distributions show that most distributions in the low band region, 800 Hz to 120 kHz or 480 kHz, dependent on tape speed, are within ±1.0 dB, while in the upper band region, 240 kHz or 960 kHz to UBE, most of the distributions are within ±2.0 dB. The differences between R1 and R2 values are indicators of system stability and also data repeatability. The difference values produced indicate system stability to be better in the low band region (±1.0 dB) than in the upper band region (±2.0 dB). Therefore, data repeatability is a function of the region of the recorder/reproducer system bandwidth in which measurements are made.

The cumulative distribution results show that at least 91.4% of the data values are within ±2.0 dB when the two classes of systems are considered separately. The results also show that at least 87.0% of the data values are within ±2.0 dB when the data from both classes are combined. The largest data spreads are in the UBE region of the system's bandwidth; therefore, it is concluded that system stability had a greater effect on data variability in the UBE region than in the 10% UBE region. However, the overall effect was less than ±2.0 dB for approximately 90% of the data values.

The standard deviations are significantly smaller at 10% UBE than at UBE, showing that the frequency response data repeatability was better at 10% UBE than at UBE. The standard deviations at UBE are nearly the same for the combined sample tape data as for the data from the second run of the reference tape at tape speeds of 30 and 120 in/s. Therefore, the larger data variability at UBE is due primarily to machine stability factors, such as azimuth, equalizer, and gain changes, rather than to tape or speed effects.

The results from this investigation indicate that at least 90% of the data variations shown were within ±2.0 dB. Therefore, it is concluded that the use of a reference tape system should produce similar results when using recorder/reproducer systems and instrumentation magnetic tapes having characteristics comparable to those used in this investigation.

RECOMMENDATION

The use of a reference tape system is recommended as a method to assure that relative frequency response variations will be less than or equal to ±2.0 dB for those applications involving the interchange of recorded data, data recorded on one system and reproduced on a different system.

APPENDIX A

TEST PROCEDURES FOR REFERENCE TAPE STUDY (WIDE-BAND INSTRUMENTATION TAPE)

APPENDIX A

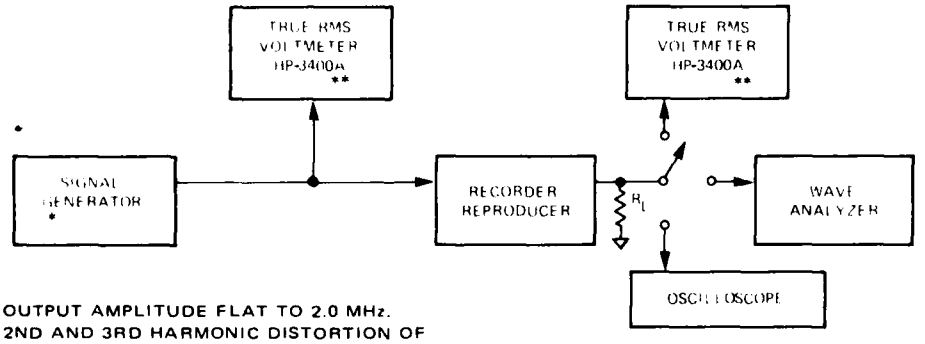
TEST PROCEDURES FOR REFERENCE TAPE STUDY
(Wide-Band Instrumentation Tape)

1. Purpose: To measure the variability of data using a set of sample tapes on selected machines at selected facilities under defined and controlled test conditions and compare the results between systems.

2. Specifications: One-half-inch tape wound on 14 inch reels suitable for recording and reproducing signals at frequencies up to 2.0 MHz.

3. Test Procedures:

3.1 Test Setup: Set up equipment as shown in figure A-1. Test equipments shown are typical and other equipment with equivalent characteristics may be used.



* (1) OUTPUT AMPLITUDE FLAT TO 2.0 MHz.
(2) 2ND AND 3RD HARMONIC DISTORTION OF SINUSOID SIGNAL MUST BE LESS THAN 0.5%.

** (1) DEDICATE FOR DURATION OF TESTS.
(2) DO NOT CHANGE SCALES DURING TESTS UNLESS ABSOLUTELY NECESSARY.

R_L AS SPECIFIED BY MANUFACTURER

Figure A-1. Reference Tape Study Test Setup.

3.2 Test Conditions: Use Standard Test Conditions shown in table A-1.

Table A-1. Standard Test Conditions

Tape	
Degauss	Bulk Degauss to at least -70 dB.
Tape Wind	Wound for normal forward direction unless otherwise required.
Track	Use the center track for all tests.
Recorder/Reproducer	
Alignment	Pre-aligned to meet manufacturers instructions and applicable sections of IRIG Documents 106-73 and 118-73.
Tape Speed	120 IPS and 30 IPS
Heads and Tape Path	Clean before each test.
Reproduce Head	Adjust reproduce head azimuth with each tape prior to each data run.
Terminations	Input and output loads as specified by manufacturer.
Wave Analyzer	Use the 1 kHz filter setting for all tests except SNR measurement. SNR measurement should be made using a 3 kHz filter setting.
Test Signal	Frequency as specified in procedure steps, amplitude as required by user or as per the manufacturers specifications.
Data Measurements	Data measurements are to be made while reproducing only. Do not make data measurements while simultaneously recording and reproducing unless specifically stated.

Note: The wide-band group classification of recorders/reproducers includes machines having either 1.5 MHz or 2.0 MHz upper frequency response limits. It is important that the correct signal frequencies be used for each of the machine classes indicated above. The following signal definitions can be applied with either bandwidth class of machine.

1. Upper-band-edge (UBE) signal frequency is either 1.5 MHz or 2.0 MHz depending on the machine classification.

2. Bias level setting: + 1 dB overbias for the 1.5 MHz class and + 2 dB for the 2.0 MHz class.

3. Reference signal frequency (record level set frequency) for setting up the record/reproduce reference parameters is 10% of the UBE signal frequency for either machine class.

3.3 Procedure Steps

3.3.1 Degauss and then mount a wide-band tape other than a test tape on the machine for initial adjustments. The entire procedure for testing should be followed through using a tape speed of 120 IPS and then completely repeated using a tape speed of 30 IPS. The tape speed of 30 IPS is set off by parentheses.

3.3.2 While simultaneously recording and reproducing an UBE signal at 120 IPS (30 IPS) adjust the reproduce head in azimuth until maximum reproduce output level is observed. Check the reproduce output with an oscilloscope to ensure that the output signal is not saturated during this adjustment.

3.3.3 Before adjusting the bias level, first reduce the record input level approximately 6 dB below that required by the user or as per manufacturers specifications. This will prevent incorrect bias level setting due to possible signal saturation. Set the bias level as follows: while simultaneously recording and reproducing an UBE signal at 120 IPS (30 IPS) adjust the bias level until the reproduce output signal amplitude is peaked and then increase the bias level until the reproduce output level has decreased by either 1 dB or 2 dB depending on the machine UBE frequency class, see note in table A-1, Standard Test Conditions.

3.3.4 While simultaneously recording and reproducing a 10% UBE test signal at 120 IPS (30 IPS) adjust the recorder input level control and the reproducer output level control until the reproduced output signal contains 1 percent third harmonic distortion and is at a level corresponding to user requirements or manufacturers specifications. These conditions establish the Normal Record Level (NRL) and the reproduce output reference level. The record input level 6 dB below NRL is defined as TRL (Test Record Level).

Note: To ensure accurate setting of the third harmonic distortion requirement be sure that the frequency response at the third harmonic frequency (30% UBE) is within ± 1 dB of the response at the fundamental frequency. Refer to paragraph 3-39.(3), page 113 in IRIG Document 118-73.

3.3.5 To check the frequency response of the recorder/reproducer record and then reproduce signals at the frequencies listed for each of the tape speeds. Maintain the record input level at TRL. It is important that the frequencies selected correspond to the tape speed (determines machine frequency bandwidth) used during initial machine tests and adjustments as outlined in Procedure Steps beginning with 3.3.1. Do not combine speed tests.

120 IPS	30 IPS
10% UBE	10% UBE
800 Hz	800 Hz
12.0 kHz	3.0 kHz
120 kHz	30 kHz
480 kHz	120 kHz
960 kHz	240 kHz
1200 kHz	300 kHz
1500 kHz	375 kHz
2000 kHz	500 kHz

Observe the reproduce output level at each of these frequencies. If the output level at any of these frequencies deviates from the level set in paragraph 3.3.4 by a value exceeding the manufacturers response specifications, adjust the equalization to satisfy the conditions of the specification and then repeat all settings and adjustments of paragraphs 3.3.2 through 3.3.5.

3.3.6 Degauss and then mount the reference tape on the machine. Repeat all procedure steps 3.3.2, 3.3.3, 3.3.4, and 3.3.5.

3.3.7 There may be some interaction between the bias level setting (paragraph 3.3.3), and the record input level setting (paragraph 3.3.4), therefore repeat the procedures of paragraphs 3.3.3 and 3.3.4 until both conditions are satisfied.

3.3.8 Perform the frequency response tests outlined in paragraph 3.3.5.

3.3.9 Rewind and degauss the reference tape. Remount the reference tape and recheck the reproduce head azimuth as outlined in paragraph 3.3.2. At the point on the reel flange marked "sensitivity" record the 10% UBE reference signal at 120 IPS (30 IPS) using NRL and observe the reproduce output level. Re adjust the reproduce gain if necessary to produce the reference output level established in paragraph 3.3.4. Read the reproduced output level (V_{rms} and dB) on the True RMS meter connected to the reproducer output. Enter the measured value in the upper left corner on the data sheet. DO NOT ADJUST THE REPRODUCE CONTROLS FOR THE REMAINDER OF THE TESTS. Recording and reproducing operations are not to be performed simultaneously unless specifically stated.

3.3.10 Conduct distortion and signal-to-noise ratio tests at 120 IPS (30 IPS) at the point on the reel flange marked "Distortion/SNR" using NRL. Record and reproduce the test signals as separate operations.

A. Record a 10% UBE signal.

1. Reproduce the recorded signal and measure the second harmonic distortion with the wave analyzer using the 1 kHz filter setting.

2. Reproduce the recorded signal and measure the third harmonic distortion with the wave analyzer using the 1 kHz filter setting.

3. Reproduce the recorded signal and measure the amplitude of the fundamental frequency with the wave analyzer using a 3 kHz filter setting.

4. Remove the 10% UBE signal from the recorder input and record without an input signal. Reproduce and measure the amplitude of the background noise in this section of the tape with the wave analyzer using a 3 kHz filter setting.

5. Enter the measured values on the data sheet.

B. Record an UBE signal.

1. Reproduce the recorded signal and measure the amplitude of the fundamental frequency with the wave analyzer using a 3 kHz filter setting.

2. Remove the UBE signal from the recorder input and record without an input signal. Reproduce and measure the amplitude of the background noise in this section of the tape with a wave analyzer using the 3 kHz filter setting.

3. Enter the measured values on the data sheet.

3.3.11 Record the response frequencies (paragraph 3.3.5) at the points marked on the reel flange using TRL. Reproduce these signals and enter the measured output levels on the data sheet in the "Reference Tape Data" column.

3.3.12 Allow the tape to wind off the supply reel and on to the takeup reel Remove the tape degauss, and remount on the machine as the supply reel. While simultaneously recording and reproducing an UBE signal at 120 IPS (30 IPS) adjust the reproduce head azimuth for maximum reproduce output level. Repeat tests as outlined in paragraphs 3.3.10, and 3.3.11 with the tape now wound in the reverse direction. DO NOT ADJUST REPRODUCER GAIN CONTROLS.

3.3.13 Rewind the reference tape back on to its original reel. Remove from the machine and degauss.

3.3.14 First degauss and then mount sample tape number 1. While simultaneously recording and reproducing an UBE signal at 120 IPS (30 IPS) on the sample tape adjust the reproduce head azimuth for maximum reproduce output level. DO NOT ADJUST REPRODUCER GAIN CONTROLS.

3.3.15 Record a 10% UBE signal at 120 IPS (30 IPS) at the point on the reel flange marked "sensitivity" using TRL. Reproduce the signal, measure the reproduced output level, and enter the measured value on the data sheet.

3.3.16 Record each of the response frequencies listed by tape speed, using TRL at the points marked on the reel flange. It is important to use only those frequencies which correspond to the tape speed used during initial machine adjustments and tests performed in Procedure Steps beginning with paragraph 3.3.1.

120 IPS	30 IPS
10% UBE	10% UBE
800 Hz	800 Hz
12 kHz	3 kHz
120 kHz	30 kHz
480 kHz	120 kHz
960 kHz	240 kHz
1200 kHz	300 kHz
1500 kHz	375 kHz
2000 kHz	500 kHz

Reproduce these signals, measure the reproduce output level, and enter each measured value on the data sheet in the appropriate "Sample Tape" data column.

3.3.17 Conduct distortion and signal-to-noise ratio tests at 120 IPS (30 IPS) at the point on the reel flange marked "Distortion/SNR" using NRL. Record and reproduce the test signals as separate operations.

A. Record a 10% UBE signal.

1. Reproduce the recorded signal and measure the second harmonic distortion with the wave analyzer using the 1 kHz filter setting.

2. Reproduce the recorded signal and measure the third harmonic distortion with the wave analyzer using the 1 kHz filter setting.

3. Reproduce the recorded signal and measure the amplitude of the fundamental frequency with the wave analyzer using a 3 kHz filter setting.

4. Remove the 10% UBE signal from the recorder input and record without an input signal. Reproduce and measure the amplitude of the background noise in this section of tape with the wave analyzer using a 3 kHz filter setting.

B. Record an UBE signal.

1. Reproduce the recorded signal and measure the amplitude of the fundamental frequency with the wave analyzer using a 3 kHz filter setting.

2. Remove the UBE signal from the recorder input and record without an input signal. Reproduce and measure the amplitude of the background noise in this section of tape with a wave analyzer using the 3 kHz filter setting.

3. Enter the measured values on the data sheet.

3.3.18 Allow the tape to wind off the supply reel and on to the takeup reel. Remove the tape, degauss, and remount on the machine as the supply reel. While simultaneously recording and reproducing an UBE signal at 120 IPS (30 IPS) adjust the reproduce head azimuth for maximum reproduce output level. Repeat the measurements of paragraphs 3.3.15 through 3.3.17 with the tape now wound in the reverse direction. Again, observe the markings on the reel flange so that approximately the same sections of tape will be used each time the tests are conducted. DO NOT ADJUST REPRODUCER GAIN CONTROLS.

3.3.19 Finally, rewind the tape forward on to its original reel, degauss and set this sample tape aside.

3.3.20 Repeat paragraphs 3.3.14 through 3.3.19 for each of the sample tapes in the order of sample numbering.

3.3.21 Repeat the steps of paragraphs 3.3.14 through 3.3.19 again using the reference tape. Enter the measured data on the data sheet. Rewind and degauss the reference tape.

3.3.22 Set the machine for a tape speed of 30 IPS and repeat all tests beginning with paragraph 3.3.1. It is important that all tests relative to either tape speed be conducted as entirely separate tests beginning with Procedure Steps 3.3.1 through 3.3.21.

REFERENCE TAPE STUDY

Data Sheet DS_____ Recorder Model_____ Head Type_____

Test Facility_____ Recorder Serial No._____ Track Used_____

Date_____ Recorder Freq. Class 1.5 MHz 2.0 MHz Room Temperature_____

Input Signal (10% UBE) at NRL: Tape Speed 30 IPS Relative Humidity_____

_____ V_{rms} * _____ dB

* Machine operated in normal forward mode.

Test Signal Frequency	Reference Tape		Sample Tape 1		Sample Tape 2		Sample Tape 3		Sample Tape 4		Sample Tape 5		Sample Tape 6		Sample Tape 7		Reference Tape	
	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*
MHz	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
10% UBE (TRL)																		
0.80 (TRL)																		
3 (TRL)																		
30 (TRL)																		
120 (TRL)																		
240 (TRL)																		
300 (TRL)																		
375 (TRL)																		
500 (TRL)																		
2nd Harm. Dist (NRL)																		
3rd Harm. Dist (NRL)																		
10% UBE (NRL) S/N																		
UBE (NRL) S/N																		

REFERENCE TAPE STUDY

Data Sheet DS_____ Recorder Model_____ Head Type_____

Test Facility_____ Recorder Serial No._____ Track Used_____

Date_____ Recorder Freq. Class___1.5 MHz___2.0 MHz_____ Room Temperature_____

Input Signal (10% UBE) at NRL: Tape Speed_____120 IPS_____ Relative Humidity_____

_____V_{rms},_____dB

* Machine operated in normal forward mode.

Test Signal Frequency	Reference Tape		Sample Tape 1		Sample Tape 2		Sample Tape 3		Sample Tape 4		Sample Tape 5		Sample Tape 6		Sample Tape 7		Reference Tape	
	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*	FWD	Rev*
KHz	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
10% UBE (TRL)																		
0.80 (TRL)																		
12 (TRL)																		
120 (TRL)																		
480 (TRL)																		
960 (TRL)																		
1200 (TRL)																		
1500 (TRL)																		
[illegible] (TRL)																		
2nd Harm. Dist(NRL)																		
3rd Harm. Dist(NRL)																		
10% UBE (NRL) S/N																		
UBE (NRL) S/N																		

ADDENDUM

REFERENCE TAPE STUDY (Wide-Band Instrumentation Tape)

1. Magnetic tape cleaners and/or winders are NOT to be used on the Reference Tape Study experimental tapes.

2. All participants are encouraged to complete all tests in the shortest time frame possible without deleting any tests in the procedures. However, if the length of time required to perform the Reference Tape Study tests becomes a problem, the following time conservation methods may be used:

a. Conduct performance measurements with the Unrecorded Reference test tape in real time and non real-time playback. Compare the data measurements between modes and if the results are within ±0.5 dB, the remainder of the tests may be made in the real-time playback mode.

b. As a second-time conservation method, the reverse data measurements (bidirectional tests) may be omitted.

3. Questions related to the test procedures or the condition of the experimental test tapes should be directed to:

D. R. HUST/E. L. LAW
PACIFIC MISSILE TEST CENTER
CODE 4320
POINT MUGU, CALIFORNIA 93042

Tel: Commercial (805) 982-7046
Autovon 351-7046

APPENDIX B

DATA PROCESSING

APPENDIX B

DATA PROCESSING

The methods used to process the accumulated field data are intended to provide the most useful results to potential standards considerations while maintaining the integrity and accuracy of the data. Due to the volume of data and the data manipulations involved, a digital computer was used to process the data measurements. Data reduction techniques employed included normalization to reference measurements, selective sorting by class of system, and averaging. The results are given in terms of cumulative distributions and standard deviations.

Upon completion of field data collection, all frequency response measurements were entered into a digital computer, checked for validity and accuracy, and stored in disk memory. The field data measurements (raw data) were then normalized by subtracting the measured values of the Unrecorded Reference tape from the measured values taken with each of the sample test tapes for each frequency and test site. The data from the second run of the reference tape were normalized along with sample tape data by test site.

The method described for normalizing the data in decibel values is equivalent to conversion of decibel values to voltage values, division by reference tape values, and the result converted back to decibel values. The results provide the frequency response of each sample tape relative to the response with the Unrecorded Reference tape at each test frequency and tape speed and for all test site recorder/reproducer systems.

The normalized data were processed to determine average values, departures from average values, standard deviations, and overall distributions. The following steps describe the routines used to process the normalized data values in decibels:

1. The average value in decibels was calculated for each of the sample tapes across all recorder/reproducer systems at each test frequency. The averages were determined for 1.5 and 2.0 MHz recorder/reproducer systems separately and also with the two bandwidths combined; calculations were made separately for each tape speed, 30 and 120 in/s.

2. The maximum positive and negative departures of the normalized data, distributed about the averages calculated in step 1 above, were determined and stored for each sample tape across all systems and at each tape speed as described in step 1, and then stored.

3. The cumulative distributions of the normalized data about the averages found in step 1 were determined and stored; e.g., X% within $\pm$0.5 dB, Y% within $\pm$1.0 dB and 100% within $\pm$Z dB. These data were also grouped as in step 1 above and for each tape speed.

4. The standard deviations of the distributions were calculated, using the equation

$$\sigma = \sqrt{\frac{\Sigma X_i^2 - \bar{X}^2}{N}},$$

where

X_i = Normalized values at a given frequency,

$\bar{X}$ = Mean value at that frequency,

N = Number of data measurements.

5. The cumulative distribution for data taken over all sample tapes was calculated by averaging the individual distributions for each sample tape at each test frequency. The results were tabulated in overall cumulative distributions in percentages for ± 0.5, ± 1.0, ± 1.5, etc., dB intervals until 100% of the data were included. The standard deviations over all sample tapes were calculated by squaring the standard deviations for each sample tape, averaging these values, and then taking the square root of the resulting overall average.

A comparison was made to determine the differences in results when using the measured values in decibels versus using the decibel-to-voltage conversions to calculate the average, the standard deviation, and the distribution values of the data. In this exercise, the data representing the largest spread (worst case) in values were used.

The calculations, when voltage instead of decibel values were used, produced a normalized average of 1.56 and a standard deviation of 0.28. The standard deviation was converted to decibels by determining the decibel departure from the mean of plus one standard deviation and of minus one standard deviation. The N and N - 1 standard deviations are also shown in the following comparison. All values determined are within 0.2 dB for both methods of calculation (voltage and decibel). The average of the absolute values for the plus and minus standard deviation values from the voltage calculations is approximately 5% lower than when the decibel values are used to calculate the standard deviations. Since agreement will be even better with a smaller data spread, only the calculations in which decibel values were used were performed for the entire data set for the study.

Data Unit Processed	Number of Data Points	Mean (dB)	Standard Deviation (N) (dB)	Standard Deviation (N - 1) (dB)	% Within Average ±2 dB
Decibels	11	3.72	1.56	1.63	82
Voltage	11	3.85	1.49	1.56	82
			$\begin{cases} +\sigma = 1.36 \\ -\sigma = -1.62 \end{cases}$	$\begin{cases} +s = 1.42 \\ -s = -1.70 \end{cases}$	

APPENDIX C

PROCESSED DATA

SAMPLE TAPE: 1 SPEED: 30 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	4	-1.57	0.63	25.0	100.0							-0.92	0.58
0.80 KHZ :	4	-2.05	0.71	50.0	75.0	100.0						-0.95	1.05
3 KHZ :	4	-2.40	0.64	25.0	100.0							-0.60	0.90
30 KHZ :	4	-1.78	0.55	50.0	100.0							-0.72	0.78
120 KHZ :	4	-1.55	0.36	75.0	100.0							-0.45	0.55
240 KHZ :	4	-1.52	0.54	75.0	100.0							-0.48	0.83
300 KHZ :	4	-1.45	0.36	75.0	100.0							-0.55	0.45
375 KHZ :	4	-1.65	0.41	75.0	100.0							-0.35	0.65
500 KHZ :	1	-0.50	0.00	100.0								0.00	0.00

SAMPLE TAPE: 2 SPEED: 30 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	4	0.65	0.54	50.0	100.0							-0.65	0.85
0.80 KHZ :	4	0.33	0.20	100.0								-0.32	0.17
3 KHZ :	4	0.10	0.39	75.0	100.0							-0.60	0.40
30 KHZ :	4	0.55	0.09	100.0								-0.05	0.15
120 KHZ :	4	0.90	0.23	100.0								-0.40	0.20
240 KHZ :	4	1.03	0.53	25.0	100.0							-0.53	0.57
300 KHZ :	4	1.13	0.54	50.0	100.0							-0.83	0.57
375 KHZ :	4	1.10	0.71	50.0	75.0	100.0						-1.10	0.80
500 KHZ :	1	-0.20	0.00	100.0								0.00	0.00

SAMPLE TAPE: 3 SPEED: 30 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	4	0.33	0.55	50.0	100.0							-0.72	0.78
0.80 KHZ :	4	-0.28	0.33	75.0	100.0							-0.22	0.58
3 KHZ :	4	-0.55	0.46	75.0	100.0							-0.45	0.55
30 KHZ :	4	-0.08	0.43	100.0								-0.42	0.48
120 KHZ :	4	0.88	0.49	75.0	100.0							-0.37	0.83
240 KHZ :	4	1.65	0.69	50.0	75.0	100.0						-0.65	1.15
300 KHZ :	4	1.98	0.90	50.0	75.0	100.0						-0.97	1.43
375 KHZ :	4	2.13	1.14	25.0	50.0	75.0	100.0					-1.13	1.88
500 KHZ :	1	0.50	0.00	100.0								0.00	0.00

SAMPLE TAPE: 4 SPEED: 30 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	4	-0.65	0.59	50.0	100.0							-0.85	0.65
0.80 KHZ :	4	-1.35	0.52	50.0	100.0							-0.55	0.85
3 KHZ :	4	-1.80	0.54	50.0	100.0							-0.70	0.80
30 KHZ :	4	-0.92	0.47	50.0	100.0							-0.57	0.73
120 KHZ :	4	0.18	0.20	100.0								-0.17	0.33
240 KHZ :	4	0.80	0.58	50.0	100.0							-0.80	0.60
300 KHZ :	4	1.10	0.50	50.0	100.0							-0.60	0.80
375 KHZ :	4	1.28	0.48	75.0	100.0							-0.27	0.80
500 KHZ :	1	0.50	0.00	100.0								0.00	0.00

SAMPLE TAPE: [illegible]

FREQ	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	MIN	MAX
10 [illegible]	1	[illegible]												-0.13	0.79
0.80 [illegible]	1	[illegible]												-0.33	0.87
[illegible]	1	[illegible]												-0.70	0.50
30 [illegible]	1	[illegible]												-0.65	1.17
120 [illegible]	1	[illegible]												-1.77	0.51
240 [illegible]	1	[illegible]												[illegible]	[illegible]
[illegible]	1	[illegible]												-1.15	1.[illegible]
[illegible]	1	[illegible]												[illegible]	[illegible]
500 [illegible]	1	[illegible]												[illegible]	[illegible]

SAMPLE TAPE: [illegible]

FREQ	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	MIN	MAX
10 [illegible]	4	[illegible]												-0.38	0.70
0.80 [illegible]	4	[illegible]												-0.15	0.78
3 [illegible]	4	[illegible]												-0.47	0.91
30 [illegible]	4	[illegible]												-0.15	0.15
120 [illegible]	4	[illegible]												[illegible]	[illegible]
240 [illegible]	1	[illegible]												[illegible]	[illegible]
[illegible]	1	[illegible]												[illegible]	[illegible]
[illegible]	1	[illegible]												[illegible]	[illegible]
500 [illegible]	1	[illegible]												0.59	0.59

SAMPLE TAPE: 5 [illegible]: [illegible] IPS [illegible] 1.5 [illegible]

[illegible]

FREQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.5	4.0	MIN	MAX
10. UBE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	0.52
0.30 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]								-0.70	0.70
3 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							-0.55	0.75
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]								[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]								[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]								[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]							[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]								[illegible]	[illegible]

SAMPLE TAPE: 6 [illegible]: [illegible] IPS [illegible]: 1.5 [illegible]

[illegible]

FREQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.5	4.0	MIN	MAX
10 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]
0.30 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	0.55
3 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]
30 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]								[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							
[illegible]				[illegible]									
[illegible]	[illegible]					[illegible]							
[illegible]	[illegible]	[illegible]		[illegible]								[illegible]	[illegible]

SAMPLE TAPE: 1 SPEED: 120 IPS CLOCK: 1.5 MHZ

CUMULATIVE DISTRIBUTION [illegible]

FREQ	N	AVG	S.D.	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	[illegible]	[illegible]	[illegible]	[illegible]							-0.62	0.78
0.80 KHZ :	5	[illegible]	[illegible]	[illegible]	[illegible]							-0.60	0.80
12 KHZ :	5	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]
120 KHZ :	5	[illegible]	[illegible]	100.0								-0.38	0.42
480 KHZ :	5	[illegible]	[illegible]	100.0								[illegible]	0.10
960 KHZ :	5	[illegible]	[illegible]	100.0								[illegible]	[illegible]
1200 KHZ :	[illegible]	[illegible]	[illegible]	[illegible]								-0.32	[illegible]
1500 KHZ :	5	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]
2000 KHZ :	1	[illegible]	[illegible]	[illegible]								[illegible]	[illegible]

SAMPLE TAPE: 2 SPEED: 120 IPS CLOCK: 1.5 MHZ

CUMULATIVE DISTRIBUTION [illegible]
[illegible] DEVIATION IN DB

FREQ	N	AVG	S.D.	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	0.30	[illegible]	100.0								-0.30	0.30
0.80 KHZ :	5	[illegible]	[illegible]	[illegible]	100.0							-0.60	0.40
12 KHZ :	5	[illegible]	[illegible]	100.0								-0.30	0.34
120 KHZ :	5	[illegible]	0.71	100.0								-0.46	0.34
480 KHZ :	5	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	0.44
960 KHZ :	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						[illegible]	[illegible]
1200 KHZ :	[illegible]	[illegible]										[illegible]	[illegible]
1500 KHZ :	[illegible]	[illegible]		[illegible]								[illegible]	[illegible]
2000 KHZ :	1	[illegible]	[illegible]	[illegible]								[illegible]	0.00

SAMPLE TAPE: 3 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	-0.14	0.45	60.0	100.0							-0.76	0.64
0.80 KHZ :	5	-0.69	0.29	100.0								-0.92	0.36
12 KHZ :	5	-0.84	0.34	80.0	100.0							-0.96	0.54
120 KHZ :	5	-0.24	0.32	80.0	100.0							-0.96	0.54
480 KHZ :	5	0.08	0.56	60.0	100.0							-0.96	0.64
960 KHZ :	5	1.74	0.70	40.0	80.0	100.0						-1.04	0.86
1200 KHZ :	5	0.72	0.40	80.0	80.0	80.0	100.0					-1.52	1.18
1500 KHZ :	5	0.78	0.76	40.0	60.0	80.0	100.0					-1.76	1.04
2000 KHZ :	1	0.00	0.00	100.0								0.00	0.00

SAMPLE TAPE: 4 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	-1.38	1.11	60.0	80.0	80.0	80.0	100.0				-2.82	1.38
0.80 KHZ :	5	-2.06	0.77	60.0	80.0	100.0						-1.44	0.86
12 KHZ :	5	-1.88	0.64	60.0	80.0	100.0						-1.88	0.92
120 KHZ :	5	-1.42	0.39	80.0	100.0							-0.58	0.48
480 KHZ :	5	-0.72	0.49	40.0	100.0							-1.48	0.72
960 KHZ :	5	0.08	1.17	60.0	80.0	80.0	80.0	100.0				-1.92	1.72
1200 KHZ :	5	-0.12	1.07	40.0	60.0	80.0	80.0	80.0	100.0			-1.82	1.04
1500 KHZ :	5	-0.16	1.16	40.0	60.0	80.0	80.0	80.0	100.0			-1.76	1.16
2000 KHZ :	1	0.00	0.00	100.0								0.00	0.00

SAMPLE TAPE: 5 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	-1.24	0.34	80.0	100.0							-0.66	0.24
0.80 KHZ :	5	-1.84	0.16	100.0								-0.16	0.24
12 KHZ :	5	-1.62	0.52	60.0	100.0							-0.88	0.62
120 KHZ :	5	-1.38	0.35	80.0	100.0							-0.62	0.38
480 KHZ :	5	-0.54	0.37	80.0	100.0							-0.46	0.64
960 KHZ :	5	0.34	0.60	60.0	100.0							-0.84	0.96
1200 KHZ :	5	0.88	0.60	60.0	100.0							-0.88	0.92
1500 KHZ :	5	1.30	0.73	40.0	80.0	100.0						-0.80	1.30
2000 KHZ :	1	0.00	0.00	100.0								0.00	0.00

SAMPLE TAPE: 6 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	-0.32	0.34	80.0	100.0							-0.58	0.32
0.80 KHZ :	5	-0.32	0.39	80.0	100.0							-0.68	0.32
12 KHZ :	5	-0.30	0.40	80.0	100.0							-0.70	0.40
120 KHZ :	5	-0.12	0.32	100.0								-0.38	0.42
480 KHZ :	5	-0.66	0.38	80.0	100.0							-0.34	0.66
960 KHZ :	5	-1.10	0.59	40.0	100.0							-0.30	0.70
1200 KHZ :	5	-1.04	0.61	60.0	100.0							-0.96	0.64
1500 KHZ :	5	-1.18	0.75	40.0	80.0	100.0						-1.32	0.68
2000 KHZ :	1	-0.50	0.00	100.0								0.00	0.00

SAMPLE TAPE: 7 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	0.04	0.43	80.0	100.0							-0.54	0.46
0.80 KHZ :	5	-0.16	0.38	80.0	100.0							-0.54	0.46
12 KHZ :	5	-0.20	0.53	60.0	100.0							-0.80	0.80
120 KHZ :	5	-0.02	0.44	80.0	100.0							-0.48	0.62
480 KHZ :	5	-0.42	0.47	60.0	100.0							-0.58	0.42
960 KHZ :	5	-0.78	0.51	60.0	100.0							-0.72	0.68
1200 KHZ :	5	-0.72	0.60	60.0	100.0							-0.78	0.92
1500 KHZ :	5	-0.88	0.67	40.0	80.0	100.0						-1.12	0.78
2000 KHZ :	1	-1.00	0.00	100.0								0.00	0.00

SAMPLE TAPE: R2 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	5	-0.10	0.30	100.0								-0.40	0.40
0.80 KHZ :	5	-0.08	0.36	100.0								-0.42	0.38
12 KHZ :	5	-0.02	0.33	80.0	100.0							-0.48	0.52
120 KHZ :	5	-0.16	0.42	80.0	100.0							-0.34	0.56
480 KHZ :	5	-0.20	0.38	80.0	100.0							-0.30	0.60
960 KHZ :	5	-0.34	0.45	60.0	100.0							-0.66	0.64
1200 KHZ :	5	-0.34	0.44	60.0	100.0							-0.66	0.54
1500 KHZ :	5	-0.40	0.40	60.0	100.0							-0.60	0.50
2000 KHZ :	1	0.00	0.00	100.0								0.00	0.00

SAMPLE TAPE: 1 SPEED: 30 IPS CLASS: 3 MHF

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	-1.07	0.56	60.0	90.0	100.0						-0.83	1.27
0.80 KHZ :	10	-2.23	0.66	40.0	80.0	90.0	100.0					-1.57	1.53
3 KHZ :	10	-2.28	0.58	50.0	90.0	100.0						-0.72	1.28
30 KHZ :	10	-2.10	0.54	60.0	90.0	100.0						-0.60	1.10
120 KHZ :	10	-1.81	0.71	60.0	80.0	90.0	100.0					-1.19	1.51
240 KHZ :	10	-1.60	0.67	60.0	90.0	100.0						-1.00	1.50
300 KHZ :	10	-1.63	0.74	70.0	80.0	90.0	100.0					-1.32	1.68
375 KHZ :	10	-1.54	0.60	80.0	90.0	100.0						-1.48	1.44
500 KHZ :	10	-1.50	0.79	70.0	90.0	90.0	100.0					-0.84	1.50

SAMPLE TAPE: 2 SPEED: 30 IPS CLASS: 3 MHF

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	0.35	0.68	70.0	90.0	90.0	100.0					-1.85	0.65
0.80 KHZ :	10	0.29	0.57	70.0	90.0	100.0						-1.29	0.71
3 KHZ :	10	0.23	0.41	80.0	100.0							-0.73	0.77
30 KHZ :	10	0.30	0.66	70.0	90.0	90.0	100.0					-1.80	0.60
120 KHZ :	10	0.58	0.78	80.0	90.0	90.0	90.0	100.0				-2.08	0.82
240 KHZ :	10	0.80	0.87	60.0	90.0	90.0	90.0	100.0				-2.29	0.71
300 KHZ :	10	1.10	1.05	70.0	80.0	80.0	90.0	100.0				-2.40	0.70
375 KHZ :	10	1.05	0.96	70.0	80.0	90.0	90.0	100.0				-2.45	0.55
500 KHZ :	10	1.20	0.79	60.0	80.0	90.0	90.0	100.0				-2.38	0.71

SAMPLE TAPE: 3 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	-0.05	1.03	60.0	80.0	90.0	90.0	90.0	100.0			-2.95	1.05
0.80 KHZ :	10	-0.49	1.05	70.0	90.0	90.0	90.0	90.0	100.0			-2.51	1.99
3 KHZ :	10	-0.60	0.95	60.0	90.0	90.0	90.0	90.0	100.0			-2.70	0.80
30 KHZ :	10	-0.34	0.92	70.0	90.0	90.0	90.0	90.0	100.0			-2.66	0.74
120 KHZ :	10	0.04	0.81	60.0	90.0	90.0	90.0	100.0				-2.24	0.66
240 KHZ :	10	1.73	0.93	60.0	90.0	90.0	90.0	90.0	100.0			-2.69	0.77
300 KHZ :	10	2.31	0.97	70.0	90.0	90.0	90.0	90.0	100.0			-2.61	1.19
375 KHZ :	10	3.11	0.99	40.0	90.0	90.0	90.0	100.0				-2.11	1.14
500 KHZ :	10	4.22	1.04	40.0	60.0	90.0	80.0	100.0				-2.42	2.58

SAMPLE TAPE: 4 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	-1.20	1.03	30.0	90.0	90.0	90.0	90.0	100.0			-2.90	0.70
0.80 KHZ :	10	-1.76	0.93	50.0	90.0	90.0	90.0	100.0				-2.34	1.26
3 KHZ :	10	-1.85	1.01	70.0	90.0	90.0	90.0	90.0	100.0			-2.85	0.85
30 KHZ :	10	-1.51	0.96	60.0	90.0	90.0	90.0	90.0	100.0			-2.69	0.91
120 KHZ :	10	-0.43	0.96	50.0	90.0	90.0	90.0	100.0				-2.47	0.93
240 KHZ :	10	0.50	1.10	60.0	90.0	90.0	90.0	90.0	90.0	100.0		-3.49	0.93
300 KHZ :	10	1.09	1.01	60.0	90.0	90.0	90.0	90.0	90.0	100.0		-3.37	0.97
375 KHZ :	10	1.84	1.00	60.0	90.0	90.0	90.0	90.0	100.0			-3.18	1.11
500 KHZ :	10	3.00	1.46	50.0	60.0	80.0	80.0	90.0	90.0	90.0	100.0	-5.30	2.00

SAMPLE TAPE: 5 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	-1.05	0.85	40.0	80.0	90.0	90.0	100.0				-2.15	1.05
0.80 KHZ :	10	-1.55	0.92	50.0	70.0	80.0	100.0					-1.85	1.55
3 KHZ :	10	-1.62	0.89	50.0	80.0	90.0	90.0	100.0				-2.18	1.12
30 KHZ :	10	-1.27	0.76	60.0	90.0	90.0	100.0					-1.93	0.77
120 KHZ :	10	-0.19	0.87	40.0	90.0	90.0	90.0	100.0				-2.01	0.99
240 KHZ :	10	0.75	1.08	60.0	80.0	90.0	90.0	90.0	100.0			-2.95	1.25
300 KHZ :	10	1.22	1.05	50.0	90.0	90.0	90.0	90.0	100.0			-2.82	0.98
375 KHZ :	10	2.06	0.99	60.0	90.0	90.0	90.0	90.0	100.0			-2.66	0.94
500 KHZ :	10	3.18	1.26	50.0	80.0	80.0	90.0	90.0	90.0	100.0		-3.38	1.62

SAMPLE TAPE: 6 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	0.16	0.39	90.0	100.0							-0.96	0.34
0.80 KHZ :	10	0.05	0.70	80.0	80.0	90.0	100.0					-1.55	1.45
3 KHZ :	10	-0.04	0.56	90.0	90.0	100.0						-1.46	0.54
30 KHZ :	10	0.05	0.58	90.0	90.0	90.0	100.0					-1.65	0.45
120 KHZ :	10	-0.19	0.53	70.0	90.0	100.0						-1.31	0.69
240 KHZ :	10	-0.33	0.51	80.0	90.0	100.0						-1.27	0.83
300 KHZ :	10	-0.35	0.55	80.0	90.0	100.0						-1.35	0.75
375 KHZ :	10	-0.36	0.61	80.0	90.0	100.0						-1.34	0.76
500 KHZ :	10	-0.34	0.73	50.0	90.0	90.0	100.0					-1.56	0.94

SAMPLE TAPE: 7 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	-0.08	0.82	10.0	60.0	90.0	100.0					-1.62	0.58
0.80 KHZ :	10	0.12	0.91	50.0	70.0	90.0	100.0					-1.52	1.88
3 KHZ :	10	0.08	0.92	50.0	60.0	90.0	90.0	100.0				-2.08	0.92
30 KHZ :	10	0.06	0.76	80.0	80.0	90.0	100.0					-1.86	0.44
120 KHZ :	10	-0.20	0.92	30.0	70.0	90.0	100.0					-1.81	1.29
240 KHZ :	10	-0.75	0.85	40.0	50.0	90.0	100.0					-1.95	0.85
300 KHZ :	10	-0.31	0.90	90.0	90.0	90.0	90.0	100.0				-2.19	0.91
375 KHZ :	10	-0.15	1.08	80.0	70.0	90.0	90.0	100.0				-2.45	1.15
500 KHZ :	10	-0.47	1.07	70.0	70.0	90.0	90.0	100.0				-2.47	1.43

SAMPLE TAPE: R2 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	10	-0.23	0.60	20.0	60.0	80.0	100.0					-1.67	0.73
0.80 KHZ :	10	0.04	0.67	60.0	80.0	100.0						-1.44	1.46
3 KHZ :	10	-0.01	0.54	60.0	90.0	100.0						-1.39	0.51
30 KHZ :	10	-0.09	0.51	50.0	90.0	100.0						-1.41	0.59
120 KHZ :	10	-0.38	0.65	70.0	90.0	90.0	100.0					-1.62	0.88
240 KHZ :	10	-0.60	0.78	80.0	90.0	90.0	100.0					-1.70	0.80
300 KHZ :	10	-0.62	0.77	70.0	90.0	90.0	100.0					-1.77	0.75
375 KHZ :	10	-0.45	0.90	70.0	90.0	90.0	90.0	100.0				-2.02	0.98
500 KHZ :	10	-0.50	1.27	30.0	70.0	80.0	80.0	90.0	100.0			-2.80	1.30

SAMPLE TAPE: 1 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	-0.11	0.43	90.9	90.9	100.0						-1.19	0.61
0.80 KHZ :	11	-0.53	0.61	54.5	90.9	100.0						-1.37	0.83
12 KHZ :	11	-0.60	0.61	54.5	90.9	100.0						-1.25	0.65
120 KHZ :	11	-0.29	0.45	72.7	100.0							-0.95	0.55
480 KHZ :	11	-0.01	0.47	72.7	100.0							-0.79	0.92
960 KHZ :	11	-0.11	0.81	63.6	72.7	90.9	100.0					-1.39	1.11
1200 KHZ :	11	-0.16	0.73	54.6	72.7	90.9	100.0					-1.64	1.06
1500 KHZ :	11	-0.09	0.87	63.6	81.8	90.9	100.0					-1.80	1.30
2000 KHZ :	11	-0.29	0.71	63.6	81.8	100.0						-1.82	1.18

SAMPLE TAPE: 2 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	0.51	0.75	63.6	90.9	90.9	90.9	100.0				-0.81	2.09
0.80 KHZ :	11	0.23	0.71	72.7	81.8	90.9	100.0					-1.03	1.87
12 KHZ :	11	0.14	0.79	63.6	90.9	90.9	90.9	100.0				-0.94	2.16
120 KHZ :	11	0.34	0.83	72.7	81.8	90.9	90.9	100.0				-1.14	2.36
480 KHZ :	11	0.05	0.79	45.5	90.9	90.9	100.0					-0.85	1.85
960 KHZ :	11	0.91	1.05	36.4	63.6	81.8	100.0					-1.01	1.79
1200 KHZ :	11	1.04	0.84	18.2	72.7	81.8	100.0					-1.04	1.66
1500 KHZ :	11	0.94	1.09	45.5	72.7	81.8	90.9	90.9	90.9	100.0		-2.14	1.96
2000 KHZ :	11	1.12	1.10	27.3	72.7	81.8	90.9	90.9	100.0			-2.62	1.38

SAMPLE TAPE: 3 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	-0.32	0.93	81.8	81.8	90.9	90.9	90.9	100.0			-2.68	1.32
0.80 KHZ :	11	-1.06	0.63	63.6	81.8	100.0						-1.34	1.06
12 KHZ :	11	-1.10	0.80	72.7	81.8	90.9	90.9	100.0				-2.10	1.10
120 KHZ :	11	-0.70	0.85	63.6	81.8	90.9	90.9	100.0				-2.30	1.20
480 KHZ :	11	0.50	1.08	72.7	81.8	90.9	90.9	90.9	100.0			-3.00	1.50
960 KHZ :	11	1.43	1.13	54.6	72.7	81.8	90.9	90.9	90.9	100.0		-3.03	1.57
1200 KHZ :	11	2.04	1.22	45.5	72.7	90.9	90.9	90.9	90.9	100.0		-3.34	1.46
1500 KHZ :	11	2.63	1.21	45.5	72.7	90.9	90.9	90.9	90.9	100.0		-3.23	1.37
2000 KHZ :	11	3.72	1.56	18.2	54.6	63.6	81.8	90.9	90.9	90.9	100.0	-3.52	2.28

SAMPLE TAPE: 4 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	-1.35	0.60	63.6	81.8	100.0						-1.15	1.05
0.80 KHZ :	11	-1.75	0.56	72.7	81.8	100.0						-1.05	1.15
12 KHZ :	11	-2.07	0.70	54.6	81.8	100.0						-1.23	1.37
120 KHZ :	11	-1.55	0.57	72.7	90.9	100.0						-0.95	1.25
480 KHZ :	11	-0.77	0.55	54.6	100.0							-0.73	0.97
960 KHZ :	11	0.25	0.78	54.6	81.8	90.9	100.0					-1.75	1.05
1200 KHZ :	11	0.72	0.64	54.6	72.7	100.0						-1.02	1.18
1500 KHZ :	11	1.25	0.68	63.6	81.8	100.0						-1.05	1.15
2000 KHZ :	11	2.51	1.01	36.4	72.7	90.9	90.9	100.0				-2.31	1.39

SAMPLE TAPE: 5 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	-1.29	0.52	63.6	90.9	100.0						-1.21	0.79
0.80 KHZ :	11	-1.93	0.57	63.6	90.9	100.0						-1.37	0.63
12 KHZ :	11	-2.07	0.61	54.6	90.9	100.0						-1.23	0.67
120 KHZ :	11	-1.58	0.51	72.7	90.9	100.0						-1.22	0.58
480 KHZ :	11	-0.61	0.62	63.6	90.9	100.0						-1.39	0.91
960 KHZ :	11	0.28	0.92	36.4	54.6	90.9	100.0					-1.78	1.22
1200 KHZ :	11	0.77	0.94	27.3	72.7	90.9	90.9	100.0				-2.07	1.23
1500 KHZ :	11	1.37	0.98	45.5	63.6	81.8	100.0					-1.87	1.33
2000 KHZ :	11	2.77	0.96	18.2	63.6	100.0						-1.37	1.23

SAMPLE TAPE: 6 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	-0.11	0.78	63.6	72.7	100.0						-1.39	1.41
0.80 KHZ :	11	-0.05	0.64	72.7	81.8	100.0						-1.45	1.25
12 KHZ :	11	-0.11	0.73	63.6	81.8	90.9	100.0					-1.39	1.51
120 KHZ :	11	-0.03	0.77	63.6	81.8	90.9	100.0					-1.67	1.43
480 KHZ :	11	-0.51	0.87	45.5	72.7	90.9	100.0					-1.79	1.31
960 KHZ :	11	-1.01	1.02	18.2	63.6	81.8	100.0					-1.89	1.21
1200 KHZ :	11	-1.10	1.00	45.5	63.6	81.8	100.0					-1.90	1.20
1500 KHZ :	11	-1.19	1.03	27.3	54.6	90.9	90.9	100.0				-2.01	1.19
2000 KHZ :	11	-1.07	0.98	45.5	63.6	81.8	100.0					-1.93	1.17

SAMPLE TAPE: 7 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	-0.15	0.55	81.8	90.9	100.0						-1.35	0.45
0.80 KHZ :	11	0.02	0.60	81.8	90.9	90.9	100.0					-1.62	0.68
12 KHZ :	11	-0.08	0.68	54.6	90.9	100.0						-1.42	0.88
120 KHZ :	11	0.05	0.64	63.6	81.8	100.0						-1.45	0.65
480 KHZ :	11	-0.45	0.89	54.6	81.8	90.9	90.9	100.0				-2.05	1.45
960 KHZ :	11	-0.96	1.08	36.4	63.6	81.8	90.9	100.0				-2.14	1.16
1200 KHZ :	11	-0.05	1.14	36.4	63.6	81.8	90.9	100.0				-2.35	1.25
1500 KHZ :	11	-0.94	1.16	54.6	54.6	81.8	81.8	100.0				-2.16	1.44
2000 KHZ :	11	-0.78	1.23	27.3	45.5	72.7	90.9	90.9	100.0			-2.52	1.58

SAMPLE TAPE: R2 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	11	0.03	0.29	81.8	100.0							-0.63	0.67
0.80 KHZ :	11	0.11	0.40	72.7	100.0							-0.61	0.69
12 KHZ :	11	0.09	0.32	90.9	100.0							-0.59	0.41
120 KHZ :	11	0.08	0.35	81.8	100.0							-0.58	0.62
480 KHZ :	11	-0.09	0.56	81.8	81.8	100.0						-1.31	1.09
960 KHZ :	11	-0.34	0.92	54.6	72.7	90.9	90.9	100.0				-2.26	1.04
1200 KHZ :	11	-0.37	0.90	45.5	81.8	90.9	90.9	100.0				-2.43	1.07
1500 KHZ :	11	-0.36	1.04	45.5	81.8	90.9	90.9	90.9	100.0			-2.64	1.36
2000 KHZ :	11	-0.26	1.14	27.3	63.6	72.7	90.9	100.0				-2.04	1.56

SAMPLE TAPE: 1 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	14	-1.36	0.61	50.0	92.9	100.0						-0.64	1.16
0.80 KHZ :	14	-2.18	0.83	28.7	64.3	92.9	100.0					-1.62	1.46
3 KHZ :	14	-2.31	0.69	50.0	64.3	100.0						-0.69	1.31
30 KHZ :	14	-2.01	0.56	64.3	85.7	100.0						-0.59	1.01
120 KHZ :	14	-1.74	0.64	64.3	85.7	100.0						-1.26	1.44
240 KHZ :	14	-1.72	0.69	64.3	78.6	100.0						-1.08	1.42
300 KHZ :	14	-1.61	0.66	78.6	85.7	92.9	100.0					-1.39	1.61
375 KHZ :	14	-1.57	0.62	78.6	85.7	100.0						-1.43	1.47
500 KHZ :	11	-1.46	0.70	45.5	81.8	100.0						-1.04	1.46

SAMPLE TAPE: 2 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	14	0.44	0.66	71.4	85.7	92.9	100.0					-1.94	1.06
0.80 KHZ :	14	0.30	0.50	78.6	92.9	100.0						-1.30	0.70
3 KHZ :	14	0.19	0.41	78.6	100.0							-0.69	0.81
30 KHZ :	14	0.37	0.57	78.6	92.9	92.9	100.0					-1.87	0.53
120 KHZ :	14	0.67	0.67	85.7	92.9	92.9	92.9	100.0				-2.17	0.73
240 KHZ :	14	0.93	0.7	64.3	92.9	92.9	92.9	100.0				-2.33	0.67
300 KHZ :	14	1.11	0.77	64.3	92.9	92.9	92.9	100.0				-2.41	0.93
375 KHZ :	14	1.21	0.82	64.3	85.7	92.9	92.9	100.0				-2.41	0.69
500 KHZ :	11	1.15	0.92	45.5	81.8	90.9	90.9	100.0				-2.15	0.85

SAMPLE TAPE: 3 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10x UBE :	14	0.03	0.93	71.4	92.9	92.9	92.9	92.9	92.9	100.0		-3.33	0.67
0.80 KHZ :	14	-0.43	0.91	71.4	85.7	85.7	92.9	92.9	100.0			-2.57	1.93
3 KHZ :	14	-0.50	0.84	64.3	92.9	92.9	92.9	92.9	100.0			-2.71	0.79
30 KHZ :	14	-0.26	0.83	71.4	92.9	92.9	92.9	92.9	100.0			-2.74	0.66
120 KHZ :	14	0.85	0.73	64.3	92.9	92.9	92.9	100.0				-2.35	0.85
240 KHZ :	14	1.71	0.87	57.1	85.7	92.9	92.9	92.9	100.0			-2.61	1.09
300 KHZ :	14	2.21	0.96	50.0	71.4	92.9	92.9	92.9	100.0			-2.51	1.29
375 KHZ :	14	2.33	1.13	14.3	50.0	85.7	100.0					-1.93	1.47
500 KHZ :	11	3.83	1.59	18.2	54.6	72.7	72.7	81.8	90.9	100.0		-3.58	2.62

SAMPLE TAPE: 4 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10x UBE :	14	-1.04	0.96	64.3	92.9	92.9	92.9	92.9	92.9	100.0		-3.06	1.04
0.80 KHZ :	14	-1.64	0.85	64.3	78.6	92.9	92.9	100.0				-2.46	1.14
3 KHZ :	14	-1.84	0.90	64.3	92.9	92.9	92.9	92.9	100.0			-2.86	0.84
30 KHZ :	14	-1.34	0.89	71.4	85.7	92.9	92.9	92.9	100.0			-2.86	1.14
120 KHZ :	14	-0.26	0.86	50.0	92.9	92.9	92.9	92.9	100.0			-2.64	0.76
240 KHZ :	14	0.59	1.05	50.0	92.9	92.9	92.9	92.9	92.9	100.0		-3.49	0.81
300 KHZ :	14	1.04	1.06	57.1	92.9	92.9	92.9	92.9	92.9	100.0		-3.44	0.96
375 KHZ :	14	1.68	0.98	42.9	78.6	92.9	92.9	92.9	100.0			-2.78	1.32
500 KHZ :	11	2.77	1.58	36.4	54.6	72.7	72.7	90.9	90.9	90.9	100.0	-3.57	2.23

SAMPLE TAPE: 5 SPEED: 30 IPS CLASS: 1.5 AND 2.0 KHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10K UBE :	14	-0.30	0.87	50.0	78.6	92.9	92.9	100.0				-2.30	0.90
0.80 KHZ :	14	-0.45	0.82	50.0	85.7	92.9	100.0					-1.95	1.45
3 KHZ :	14	-1.57	0.81	57.1	85.7	92.9	92.9	100.0				-3.23	1.07
30 KHZ :	14	-1.13	0.73	57.1	78.6	92.9	92.9	100.0				-2.37	0.93
120 KHZ :	14	-0.93	0.78	42.9	85.7	92.9	92.9	100.0				-2.14	0.86
240 KHZ :	14	0.76	0.86	57.1	85.7	92.9	92.9	92.9	100.0			-2.96	1.24
300 KHZ :	14	1.19	0.94	50.0	85.7	92.9	92.9	92.9	100.0			-2.79	1.01
375 KHZ :	14	1.93	0.97	42.9	78.6	92.9	92.9	100.0				-2.45	1.15
500 KHZ :	11	2.94	1.43	36.4	63.6	72.7	81.8	90.9	90.9	100.0		-3.14	1.86

SAMPLE TAPE: 6 SPEED: 30 IPS CLASS: 1.5 AND 2.0 KHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10K UBE :	14	0.16	0.42	85.7	100.0							-0.96	0.84
0.80 KHZ :	14	0.02	0.64	78.6	85.7	92.9	100.0					-1.52	1.48
3 KHZ :	14	-0.12	0.56	64.3	92.9	100.0						-1.38	0.62
30 KHZ :	14	0.06	0.51	92.9	92.9	92.9	100.0					-1.66	0.41
120 KHZ :	14	-0.23	0.60	71.4	92.9	100.0						-1.37	0.77
240 KHZ :	14	-0.35	0.55	78.6	85.7	100.0						-1.35	0.35
300 KHZ :	14	-0.43	0.51	78.6	85.7	100.0						-1.79	0.30
375 KHZ :	14	-0.47	0.71	78.6	85.7	92.9	100.0					-1.54	0.94
500 KHZ :	11	-0.33	0.70	54.6	90.9	90.9	100.0					-1.37	0.93

SAMPLE TAPE: 7 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	14	0.12	0.77	71.4	78.6	92.9	100.0					-1.81	0.88
0.80 KHZ :	14	0.31	0.79	64.3	78.6	85.7	100.0					-1.81	1.79
3 KHZ :	14	0.11	0.81	57.1	85.7	92.9	92.9	100.0				-2.11	6.89
30 KHZ :	14	0.20	0.68	85.7	85.7	92.9	100.0					-2.00	0.50
120 KHZ :	14	-0.13	0.85	42.9	78.6	92.9	100.0					-1.97	1.13
240 KHZ :	14	-0.24	0.87	35.7	85.7	92.9	92.9	100.0				-2.56	0.94
300 KHZ :	14	-0.24	0.94	50.0	78.6	92.9	92.9	100.0				-2.25	1.04
375 KHZ :	14	-0.19	0.99	42.9	64.3	92.9	92.9	100.0				-2.41	1.19
500 KHZ :	11	0.05	1.21	18.2	63.6	81.8	90.9	100.0				-2.45	1.45

SAMPLE TAPE: R2 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	14	-0.19	0.62	85.7	92.9	92.9	100.0					-1.71	0.69
0.80 KHZ :	14	0.06	0.58	85.7	85.7	100.0						-1.46	1.44
3 KHZ :	14	-0.03	0.47	71.4	92.9	100.0						-1.37	0.53
30 KHZ :	14	-0.02	0.45	85.7	92.9	100.0						-1.48	0.52
120 KHZ :	14	-0.31	0.62	64.3	92.9	92.9	100.0					-1.39	0.81
240 KHZ :	14	-0.47	0.82	50.0	78.6	85.7	100.0					-1.73	0.77
300 KHZ :	14	-0.59	0.92	28.6	78.6	85.7	100.0					-1.91	0.99
375 KHZ :	14	-0.61	1.07	35.7	64.3	85.7	92.9	100.0				-2.39	1.11
500 KHZ :	11	-0.47	1.21	36.4	72.7	81.8	90.9	90.9	100.0			-2.83	1.27

SAMPLE TAPE: 1 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	16	-0.01	0.50	75.0	[illegible]	[illegible]						-1.29	1.01
0.80 KHZ :	16	-0.33	0.44	68.8	[illegible]	[illegible]						-1.47	1.23
12 KHZ :	16	-0.41	0.61	62.5	87.5	100.0						-1.39	0.91
120 KHZ :	16	-0.21	0.44	81.3	[illegible]	[illegible]						-1.09	0.71
480 KHZ :	16	-1.09	0.44	[illegible]	[illegible]							-0.01	0.79
960 KHZ :	16	-1.94	0.77	68.8	87.5	93.8	93.8	100.0				-2.06	0.94
1200 KHZ :	16	-1.89	0.74	50.0	87.5	[illegible]	100.0					-1.91	0.89
1500 KHZ :	16	-1.87	0.87	43.8	68.8	93.8	93.8	100.0				-2.13	1.37
2000 KHZ :	12	-2.09	0.95	50.0	83.3	91.7	91.7	100.0				-1.41	2.09

SAMPLE TAPE: 2 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	16	0.44	0.65	75.0	93.8	93.8	93.8	100.0				-0.74	2.16
0.80 KHZ :	16	0.13	0.62	75.0	93.8	93.8	100.0					-0.99	1.91
12 KHZ :	16	0.14	0.67	75.0	93.8	93.8	93.8	100.0				-0.84	2.16
120 KHZ :	16	0.31	0.71	75.0	87.5	93.8	93.8	100.0				-1.11	2.39
480 KHZ :	16	0.82	0.69	56.3	87.5	93.8	100.0					-1.02	1.38
960 KHZ :	16	2.25	0.93	37.5	75.0	87.5	100.0					-1.95	1.75
1200 KHZ :	16	1.15	0.80	37.5	75.0	93.8	100.0					-1.13	1.55
1500 KHZ :	16	1.05	1.13	31.3	75.0	87.5	87.5	93.8	93.8	93.8	100.0	-3.55	1.33
2000 KHZ :	12	0.98	1.18	41.7	58.3	75.0	91.7	100.0				-2.48	1.52

SAMPLE TAPE: 3 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10x UBE :	16	-0.26	0.81	75.0	87.5	93.8	93.8	93.8	100.0			-2.74	1.26
0.80 KHZ :	16	-0.94	0.56	62.5	93.8	100.0						-1.46	0.94
12 KHZ :	16	-0.96	0.72	68.8	93.8	93.8	93.8	100.0				-2.24	0.96
120 KHZ :	16	-0.56	0.76	68.8	87.5	93.8	93.8	100.0				-2.44	1.06
480 KHZ :	0	0.61	0.96	62.5	87.5	93.8	93.8	93.8	93.8	100.0		-3.11	1.39
960 KHZ :	16	1.53	1.07	43.8	81.3	93.8	93.8	93.8	93.8	100.0		-3.13	1.47
1200 KHZ :	16	1.13	1.14	43.8	75.0	93.8	93.8	93.8	93.8	100.0		-3.42	1.38
1500 KHZ :	16	1.67	1.15	43.8	68.8	87.5	93.8	93.8	93.8	100.0		-3.27	1.33
2030 KHZ :	12	3.41	1.01	33.3	41.7	91.7	66.7	75.0	83.3	100.0		-3.41	2.59

SAMPLE TAPE: 4 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10x UBE :	16	-1.38	0.79	62.5	75.0	93.8	93.8	100.0				-2.04	1.36
0.80 KHZ :	16	-1.84	0.95	32.5	87.5	93.8	100.0					-1.66	1.24
12 KHZ :	16	-2.03	0.89	56.3	81.3	100.0						-1.27	1.33
120 KHZ :	16	-1.51	0.83	75.0	93.8	100.0						-0.99	1.21
480 KHZ :	16	-0.88	0.51	50.0	100.0							-0.81	0.99
960 KHZ :	16	0.19	0.81	56.3	75.0	87.5	93.8	100.0				-2.19	1.21
1200 KHZ :	16	0.70	0.97	50.0	75.0	87.5	93.8	93.8	100.0			-2.70	1.40
1500 KHZ :	16	1.24	1.08	50.0	75.0	87.5	93.8	93.8	93.8	100.0		-3.24	1.56
2000 KHZ :	12	2.30	1.19	41.7	58.3	75.0	83.3	100.0				-2.30	1.60

SAMPLE TAPE: 5 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	16	-1.38	0.47	68.8	93.8	100.0						-1.92	0.78
0.80 KHZ :	16	-1.90	0.48	75.0	93.8	100.0						-1.48	0.60
12 KHZ :	16	-1.53	0.62	56.3	93.8	100.0						-1.57	0.93
120 KHZ :	16	-1.52	0.47	75.0	93.8	100.0						-1.28	0.52
480 KHZ :	16	-0.59	0.56	68.8	93.8	100.0						-1.41	0.89
960 KHZ :	16	0.30	0.83	50.0	81.3	93.8	100.0					-1.80	1.20
1200 KHZ :	16	0.31	0.95	43.8	81.3	93.8	93.8	100.0				-2.11	1.19
1500 KHZ :	16	1.35	0.91	43.8	68.8	87.5	100.0					-1.85	1.35
2000 KHZ :	12	2.54	1.20	16.7	33.3	91.7	91.7	91.7	100.0			-2.54	1.46

SAMPLE TAPE: 6 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	16	-0.18	0.88	68.8	81.3	100.0						-1.32	1.48
0.80 KHZ :	16	-0.13	0.59	75.0	87.5	100.0						-1.37	1.33
12 KHZ :	16	-0.17	0.65	62.8	87.5	93.8	100.0					-1.33	1.57
120 KHZ :	16	-0.06	0.67	75.0	87.5	93.8	100.0					-1.64	1.46
480 KHZ :	16	-0.56	0.76	56.3	81.3	93.8	100.0					-1.74	1.36
960 KHZ :	16	-1.04	0.91	31.3	75.0	87.5	100.0					-1.86	1.24
1200 KHZ :	16	-1.06	0.89	50.0	75.0	87.5	100.0					-1.92	1.19
1500 KHZ :	16	-1.19	0.95	31.3	68.8	93.8	93.8	100.0				-2.01	1.19
2000 KHZ :	12	-1.02	0.95	41.7	66.7	83.3	100.0					-1.67	1.13

SAMPLE TAPE: 7 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	16	-0.09	0.52	75.0	93.8	100.0						-1.41	0.59
0.80 KHZ :	16	-0.04	0.55	68.8	93.8	93.8	100.0					-1.56	0.74
12 KHZ :	16	-0.12	0.64	50.0	93.8	100.0						-1.38	0.92
120 KHZ :	16	0.03	0.58	56.3	87.5	100.0						-1.42	0.68
480 KHZ :	16	-0.44	0.79	56.3	87.5	93.8	93.8	100.0				-2.06	1.44
960 KHZ :	16	-0.91	0.95	37.5	75.0	87.5	93.8	100.0				-2.19	1.11
1200 KHZ :	16	-0.88	1.01	37.5	68.8	87.5	93.8	100.0				-2.46	1.18
1500 KHZ :	16	-0.92	1.03	50.0	62.5	87.5	87.5	100.0				-2.18	1.42
2000 KHZ :	12	-0.80	1.18	33.3	50.0	83.3	91.7	100.0				-2.50	1.69

SAMPLE TAPE: R2 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	16	-0.01	0.30	87.5	100.0							-0.59	0.71
0.80 KHZ :	16	0.05	0.40	68.8	100.0							-0.55	0.75
12 KHZ :	16	0.06	0.33	87.5	100.0							-0.58	0.44
120 KHZ :	16	0.01	0.39	62.5	100.0							-0.51	0.69
480 KHZ :	16	-0.12	0.61	31.3	87.5	100.0						-1.27	1.13
960 KHZ :	16	-0.34	0.80	50.0	81.3	93.8	93.8	100.0				-2.26	1.04
1200 KHZ :	16	-0.39	0.79	50.0	87.5	87.5	93.8	100.0				-2.44	1.06
1500 KHZ :	16	-0.77	0.99	56.3	87.5	87.5	93.8	93.8	100.0			-2.62	1.38
2000 KHZ :	12	-0.24	1.09	75.0	66.7	75.0	91.7	100.0				-2.06	1.54

SAMPLE TAPE: 1 - 7 SPEED: 30 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	28	-0.15	0.53	57.1	100.0							-0.97	0.85
0.80 KHZ :	28	-0.60	0.47	71.4	96.4	100.0						-0.35	1.05
3 KHZ :	28	-0.89	0.51	53.6	100.0							-0.70	0.90
30 KHZ :	28	-0.34	0.39	78.6	100.0							-0.72	0.78
120 KHZ :	28	0.09	0.36	85.7	100.0							-0.77	0.83
240 KHZ :	28	0.34	0.65	53.6	89.3	96.4	100.0					-1.55	1.15
300 KHZ :	28	0.47	0.60	53.6	96.4	100.0						-0.97	1.43
375 KHZ :	28	0.43	0.75	53.6	78.6	96.4	100.0					-1.22	1.88
500 KHZ :	7	0.00	0.00	100.0								0.00	0.00

SAMPLE TAPE: 1 - 7 SPEED: 30 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	70	-0.55	0.80	51.4	87.1	92.9	95.7	97.1	100.0			-2.95	1.27
0.80 KHZ :	70	-0.80	0.86	58.6	78.6	95.7	97.1	98.6	100.0			-2.51	1.99
3 KHZ :	70	-0.67	0.79	60.0	88.6	94.3	94.3	97.1	100.0			-2.85	1.28
30 KHZ :	70	-0.69	0.75	70.0	88.6	91.4	97.1	97.1	100.0			-2.69	1.10
120 KHZ :	70	-0.21	0.81	57.1	85.7	91.4	94.3	100.0				-2.47	1.51
240 KHZ :	70	0.20	0.89	60.0	87.1	92.9	94.3	95.7	98.6	100.0		-3.40	1.50
300 KHZ :	70	0.47	0.92	64.3	87.1	91.4	92.9	95.7	98.6	100.0		-3.42	1.68
375 KHZ :	70	0.90	0.91	58.6	82.9	92.9	92.9	97.1	100.0			-2.94	1.44
500 KHZ :	70	1.41	1.11	45.7	75.7	84.3	91.4	97.1	97.1	98.6	100.0	-3.80	2.28

SAMPLE TAPE: 1 - 7 SPEED: 30 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	98	-0.44	0.76	66.3	89.8	94.9	96.9	98.0	98.0	100.0		-3.06	1.16
0.80 KHZ :	98	-0.74	0.77	63.3	83.7	91.8	93.8	99.0	100.0			-2.57	1.93
3 KHZ :	98	-0.87	0.73	62.2	91.8	95.9	95.9	98.0	100.0			-2.86	1.31
30 KHZ :	98	-0.89	0.69	74.5	89.8	93.9	96.9	98.0	100.0			-2.96	1.14
120 KHZ :	98	-0.83	0.75	63.2	88.8	94.9	95.9	99.0	100.0			-2.64	1.44
240 KHZ :	98	0.24	0.83	58.2	86.7	94.9	94.9	96.9	99.0	100.0		-3.49	1.43
300 KHZ :	98	0.47	0.84	61.2	84.7	93.9	94.9	96.9	99.0	100.0		-3.44	1.61
375 KHZ :	98	0.77	0.90	48.0	75.5	92.9	95.9	99.0	100.0			-2.79	1.47
500 KHZ :	77	1.39	1.02	36.4	70.1	87.1	87.0	94.8	96.1	98.7	100.0	-3.57	2.63

SAMPLE TAPE: 1 - 7 SPEED: 120 IPS CLASS: 1.5 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) + - DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	35	-0.65	0.55	74.3	94.3	97.1	97.1	100.0				-2.02	1.39
0.80 KHZ :	35	-0.98	0.44	30.0	97.1	100.0						-1.44	0.26
12 KHZ :	35	-0.95	0.47	71.4	97.1	100.0						-1.08	0.92
120 KHZ :	35	-0.69	0.34	88.6	100.0							-0.62	0.62
480 KHZ :	35	-0.30	0.45	71.4	100.0							-0.98	0.72
960 KHZ :	35	-0.73	0.60	62.9	88.6	97.1	97.1	100.0				-2.09	1.31
1200 KHZ :	35	0.53	0.79	60.0	88.6	94.3	97.1	97.1	100.0			-3.09	1.44
1500 KHZ :	35	0.45	0.93	40.0	74.3	91.4	97.1	97.1	100.0			-3.98	1.93
2000 KHZ :	7	-1.29	0.01	100.0								0.00	0.00

SAMPLE TAPE: 1 - 7 SPEED: 120 IPS CLASS: 2 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	77	-0.69	0.68	70.1	85.7	97.4	97.4	98.7	100.0			-2.68	2.09
0.80 KHZ :	77	-1.01	0.62	68.8	85.7	97.4	100.0					-1.62	1.87
12 KHZ :	77	-1.12	0.70	59.7	87.0	96.1	97.4	100.0				-2.10	2.16
120 KHZ :	77	-0.83	0.68	68.8	87.0	96.1	97.4	100.0				-2.30	2.36
480 KHZ :	77	-0.43	0.78	58.4	88.3	94.8	97.4	98.7	100.0			-3.00	1.85
960 KHZ :	77	-0.17	0.98	42.9	67.5	85.7	97.4	98.7	98.7	100.0		-3.03	1.79
1200 KHZ :	77	0.05	0.95	42.9	71.4	89.6	96.1	98.7	98.7	100.0		-3.34	1.66
1500 KHZ :	77	0.26	1.06	40.3	68.8	88.3	93.5	97.4	97.4	100.0		-3.44	1.96
2000 KHZ :	77	0.85	1.11	38.6	64.9	85.7	93.5	96.1	98.7	98.7	100.0	-3.52	2.28

SAMPLE TAPE: 1 - 7 SPEED: 120 IPS CLASS: 1.5 AND 2.0 MHZ

FREQ	N	AVG	S.D.	CUMULATIVE DISTRIBUTION (%) +/- DEVIATION IN DB 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	MIN	MAX
10% UBE :	112	-0.68	0.65	71.4	87.5	97.3	97.3	99.1	100.0			-2.74	2.16
0.80 KHZ :	112	-1.00	0.59	69.6	90.2	97.3	100.0					-1.66	1.91
12 KHZ :	112	-1.07	0.66	62.5	90.2	97.3	98.2	100.0				-2.24	2.16
120 KHZ :	112	-0.79	0.60	72.3	90.2	97.3	99.2	100.0				-2.44	2.39
480 KHZ :	112	-0.39	0.70	60.7	91.1	96.4	98.2	99.1	99.1	100.0		-3.11	1.88
960 KHZ :	112	-0.13	0.90	45.5	78.6	90.2	96.4	99.1	99.1	100.0		-3.13	1.75
1200 KHZ :	112	0.13	0.92	44.6	76.8	92.0	96.4	98.2	99.1	100.0		-3.42	1.55
1500 KHZ :	112	0.39	1.04	42.0	68.8	89.3	93.9	97.3	97.3	99.1	100.0	-3.55	1.85
2000 KHZ :	84	0.76	1.23	34.5	56.0	81.0	88.1	95.2	97.6	100.0		-3.41	2.59

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